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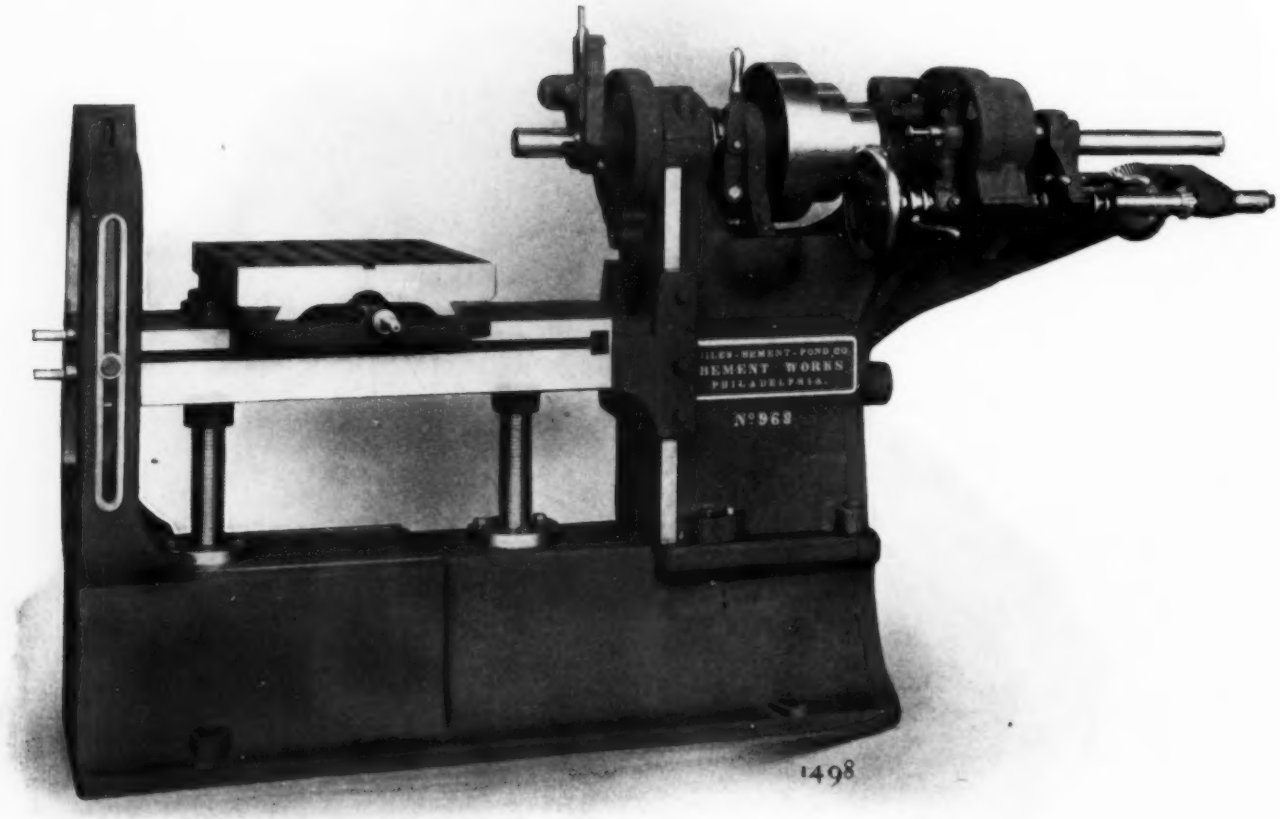

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Vertical Spindle Surface Grinder

A Machine of Novel Design and Construction Utilizing a Large Cup Wheel for Rapidly and Accurately Grinding Flat Surfaces

SPECIAL CORRESPONDENCE

We illustrate herewith a novel and interesting surface-grinding machine built by the Pratt & Whitney Company and designed for the rapid and accurate finishing of plane surfaces, faces of cylindrical rings, disks, etc. This grinder is fitted with a vertical spindle carrying a large cup wheel, whose rim covers the work for its entire width, thus reducing the latter very rapidly and insuring flatness of surface. The wheel spindle is bored through from end to end to permit the passage of a liberal quantity of water which is carried out by centrifugal force between the face of the wheel, and the piece being ground, thus keeping the work cool, and at the same time preventing emery dust and metal particles from reaching the bearing surfaces. The work while being ground is secured to the table or held by a magnetic chuck, the table automatically traveling back and forth under the wheel with any desired stroke within the limit of 36 inches. The water as it passes from the work is returned to a tank where it is separated from the emery and forced back through the spindle by means of a pump attached to the tank.

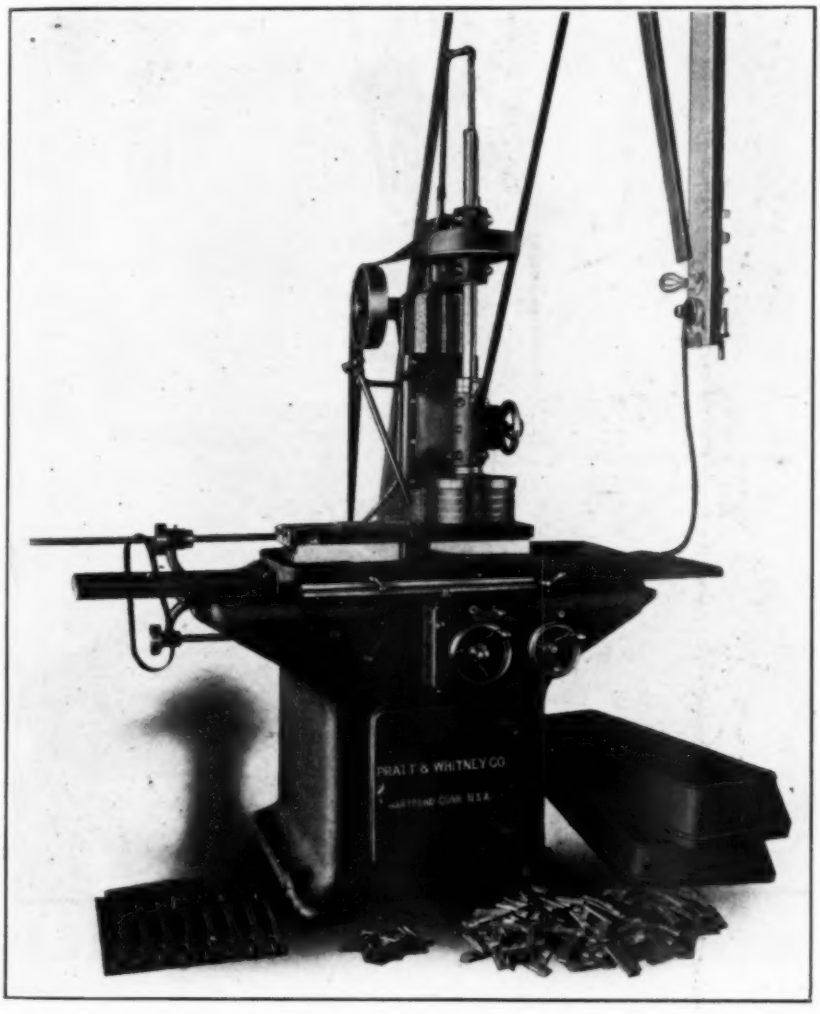


FIG. 1. VERTICAL SPINDLE SURFACE GRINDER WITH MAGNETIC CHUCK

The Bed and Table

The half tones, Figs. 1 and 2, show the design of the machine clearly, the first engraving representing also the manner in which small flat pieces are handled by the aid of the magnetic chuck, while the latter view shows the method of grinding the faces of rings and similar parts which are held on a rotary table and revolved as they are fed under the wheel. As will be seen from these engravings and the elevations in Figs. 3 and 4, the machine is of heavy construction and well adapted to withstand vibration, the bed being cast in a single piece to which the upright for the wheel slide is securely bolted. The water tank is formed integrally with the bed and the latter is tied firmly by cross ribs in all directions and rests upon three points on the floor.

The reciprocating table, as shown in cross section in Fig. 5, slides on one V and one flat way provided with self-oiling rollers, and is actuated through rack and pinion, the latter being driven through bevel and worm gearing and reversing clutches, from the pulley at the rear.

The general drawings also show the arrangement of the pulleys and belting for operating the machine, and as will be seen, a single belt at the rear forms the main driving medium, the pulley over which this passes having a larger step from which the spindle is driven, while its hub extended inwardly to form a quill carries a smaller two-step pulley, the inner section of which is belted to a pulley above for driving the mechanism which operates the table; the other portion of this smaller pulley is utilized for driving the pump. The driving pulley, which is thus adapted for the four belts, is mounted freely on a shaft, which is fixed in a bearing secured to the rear of the bed and supported at the outer end by the curved bracket shown bolted to the base. A slot is milled along the top of this fixed shaft nearly from end to end and felt is packed in the pocket thus formed, lubricant being introduced through an oiler near the outer end of the shaft. The long bearing of the pulley and its quill on the shaft is in this way kept thoroughly lubricated, and there is no opportunity for dust to work into the bearing. This arrangement is brought out clearly in the sectional drawing, Fig. 5, where *A* is the main pulley, and *B* the pulley for driving shaft *C*, which operates the table.

The Table Drive

The reciprocating mechanism will be understood by referring to this drawing and to Fig. 6, similar reference letters being used in the two engravings. A worm on shaft *C*, Fig. 5, engages worm wheel *D*, Fig. 6, which drives a shaft to which is feathered a double-ended clutch *E*, placed between bevel reversing gears *F F*. These gears mesh with the bevel *G*, which drives the pinion meshing with the rack for reciprocating the table, and as the clutch *E* is slid to and fro by the movement of the

table the gears F are thrown alternately into action to reverse the movement of the table. The third bevel pinion H at the front of the group of bevel gears is turned by hand wheel I to move the table by hand. When the table is to be operated automatically the knob at the center of the hand wheel is pulled out, this causing a pivoted key in the hand-wheel shaft to swing back into its seat and disconnect the hand wheel, thus leaving it stationary during the power traverse of the table. When the knob is pushed in again the automatic travel is stopped, and the hand wheel re-engaged with its shaft.

The reversing clutch is actuated by means of adjustable dogs at the front of the table which contact with rocker J, knife-edge spring plugs facilitating the rapid shifting of the clutch in either direction. The rocking member controlled by the dogs on the table also actuates the power feed for the vertical spindle slide.

The Vertical Slide and Feed

A vertical section through this slide showing the spindle and its bearings, is given in Fig. 7. The slide may be fed up and down either by hand or automatically. For operating the slide quickly the knob K at the right-hand side is released and the hand wheel may then be turned to lift the slide and wheel rapidly or to bring the wheel down rapidly toward the work. The power feed is operated by the ratchet wheel L and pawl M, Fig. 6. As the toothed sector N is moved by the dogs on the table striking tappet J, bell crank O, operated by a pinion meshing with N, is rocked to actuate rod P and the rocker which carries pawl M and the latter then moves the ratchet wheel by as many teeth as the mechanism is set to cover. On its backward stroke the pawl carrier is brought against stop screw Q, the slot in the end of rod P permitting this movement, and the position of the screw determines the rate of feed. Each tooth of the ratchet wheel represents a feeding movement of the vertical slide and wheel of 0.0001 inch and any rate of feed from this up to 0.0012 inch (equivalent to 12 teeth) may be obtained by properly adjusting the screw.

The dial R at the rear of the ratchet wheel is graduated and, as it is provided with a friction device, may be easily adjusted upon its bearing to bring the zero line into coincidence with a zero line as a plate behind it. By means of this dial the grinding wheel may be accurately fed down by the hand wheel S to any desired point.

How the Wheel Slide is Controlled

The connecting members between the feed mechanism at the front of the machine and the spindle slide are shown in the drawing Fig. 8, S being the hand wheel for the fine adjustment of the grinding wheel to the work, and L the ratchet for the automatic feed. K is the knob referred to in connection with Fig. 7 for releasing the power feed mechanism when the vertical slide is to be operated quickly by the hand wheel at the side of the slide. Horizontal shaft T, Figs. 6 and 8, which is placed crosswise of the bed and which receives motion from the ratchet feed wheel or the hand wheel S, is connected by bevel gears with a vertical shaft U which passes up at the rear of the slide where a worm secured at its upper end engages a worm wheel for operating the pinion which moves the slide up and down. The worm gear is connected to its shaft by a friction V and when knob K is loosed, the slide is free to be operated by the hand wheel W; while, with the knob tightened the feed is by means of the automatically operated ratchet wheel or by the hand wheel at the front of that ratchet mechanism, this latter hand feed being of course much finer than the movement obtained direct by the hand wheel W at the side of the vertical slide.

The Spindle Construction

Now that we have been over in a general way the main features in connection with the feeding mechanism, some few particulars regarding the spindle and wheel may be of interest. Referring again to Fig. 7 it will be observed that the spindle runs in self-oiling babbitt bearings and ball thrust bearings are provided at top and bottom of the main bearing to take any vertical thrust there may be and also carry the downward thrust due to the weight of the spindle and wheel. The driving pulley for the spindle has its own bearing independent of the spindle itself and the latter slides through this bearing without its alinement in any way being affected by the pull of the belt. This construction will be clear upon inspection of Fig. 9 which shows plainly the scheme referred to. It will be noticed that this sketch, as well as the other line drawings, shows a slight modification in the design of the top of the column from that indicated in the half-tones, the construction as now followed doing away with the upper capped bearing above the pulley which was included in the construction of the machine photographed.

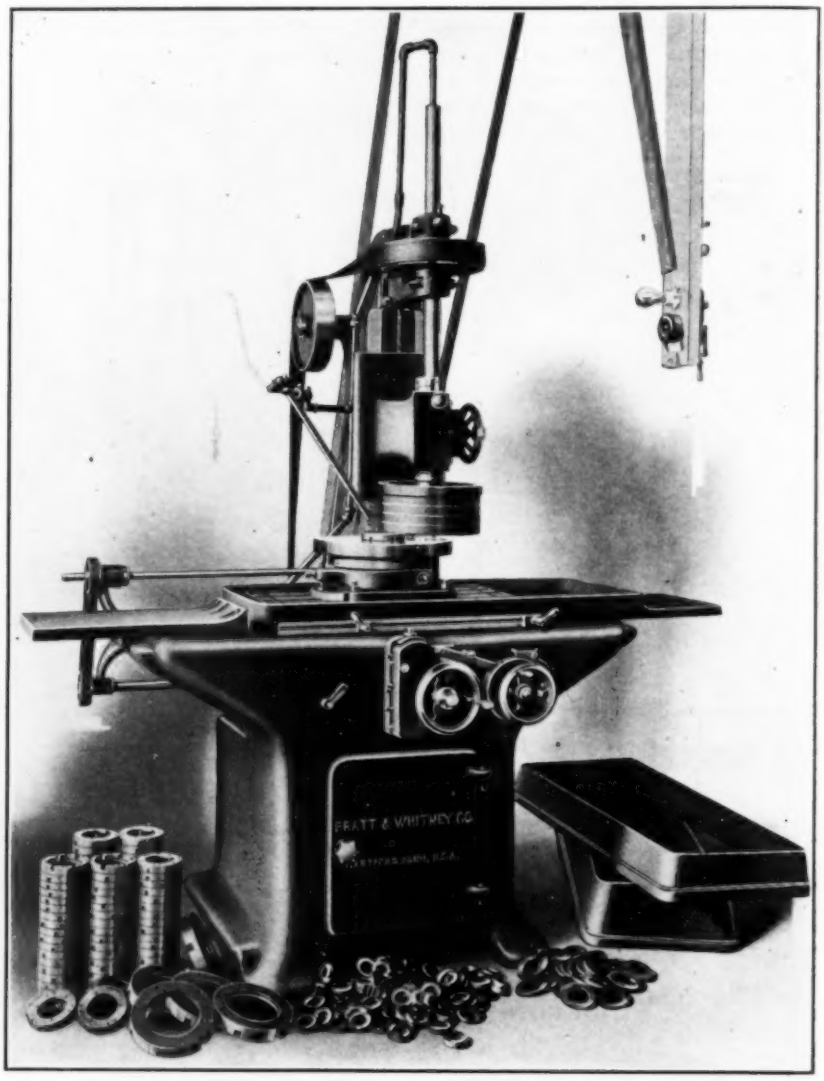


FIG. 2. VERTICAL SPINDLE SURFACE GRINDER WITH ROTARY TABLE

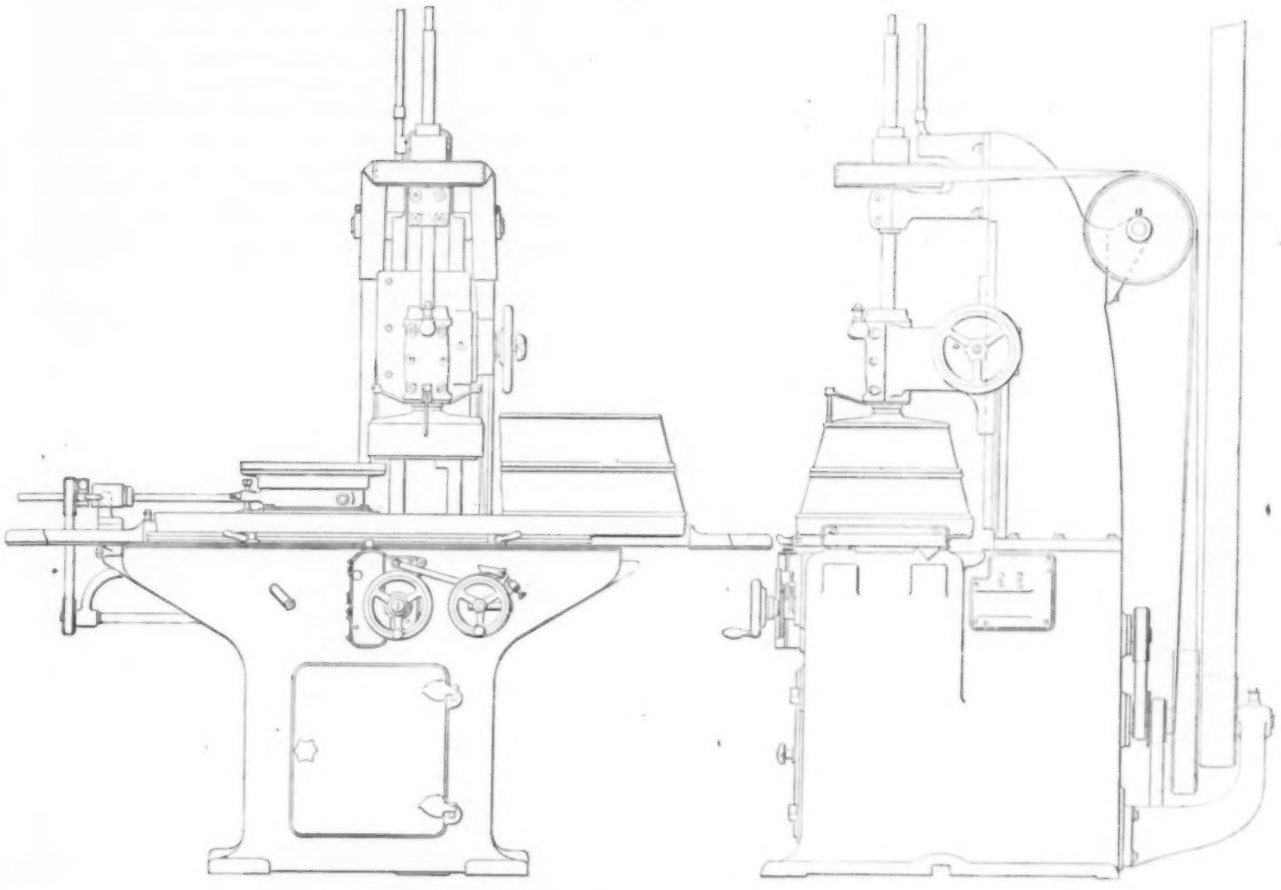


FIG. 3. FRONT AND RIGHT-HAND ELEVATIONS OF SURFACE GRINDER

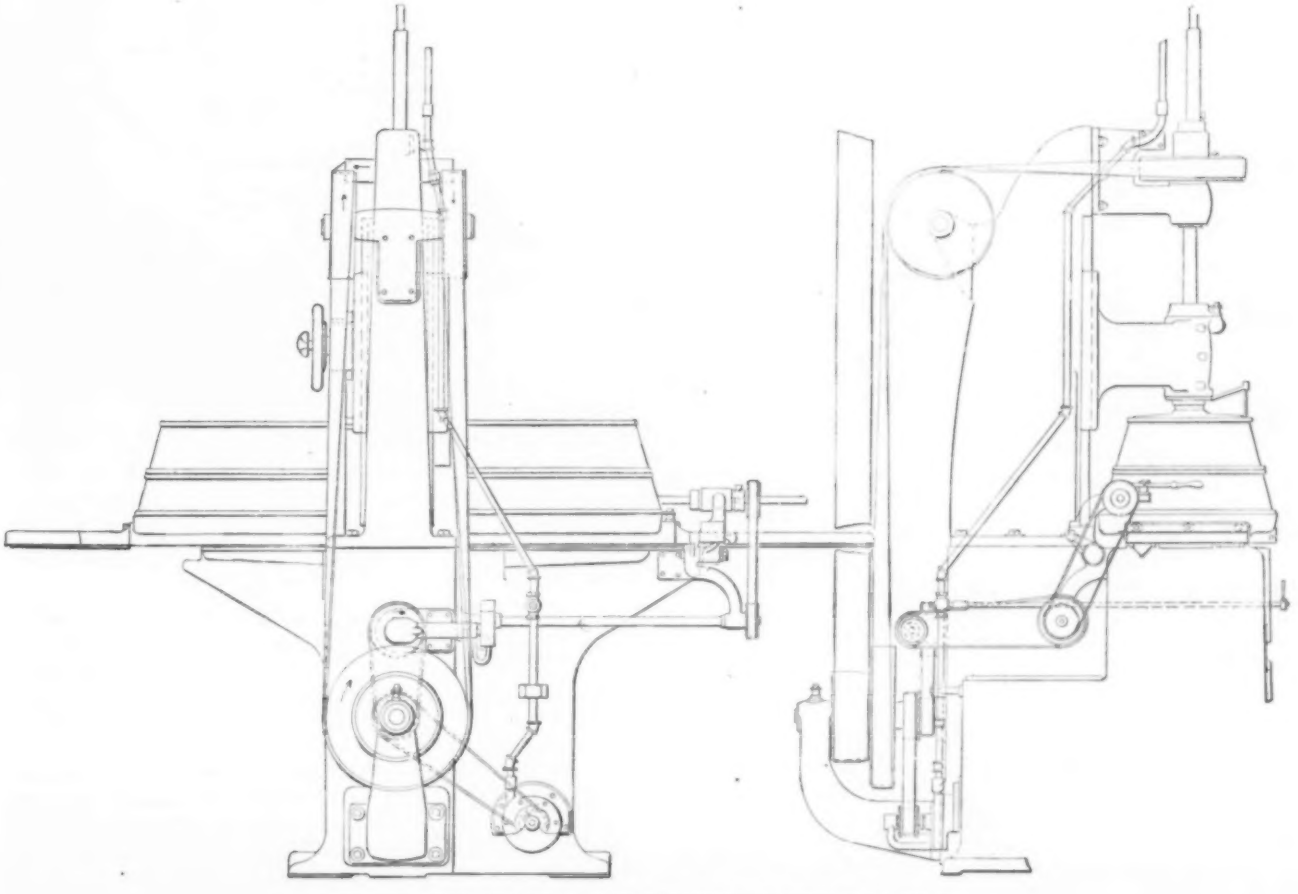


FIG. 4. REAR AND LEFT-HAND ELEVATIONS OF SURFACE GRINDER

The pulley *a*, in Fig. 9, is a running fit on the upper end of a long sleeve or quill *b*, whose lower half is securely fitted in the column arm at *c*. In this half of the quill is fitted to run nicely a sleeve *d*; which is feathered to the spindle, and in which the latter is made a nice sliding fit. The upper end of *d* is bored to give the spindle considerable clearance on all sides, and no possible strain due to belt pull can be transferred from pulley to spindle as the sole connection between the two is by means of the driver at *e*, which has a feather fitting the spindle spline, and a stud engaging an opening in the extension of the pulley. The sleeve *d*, through which the spindle is fitted, forms a neat bearing for the spindle, and at the same time provides a construction which keeps the splined surface from revolving in contact with the main bearing member.

The method of oiling is also shown in this drawing. Lubricant put into the oiler at the top of driver *e* passes down to cup *f*, from which it is free to flow down between the pulley and the quill, on which it is mounted, until it reaches the chamber above spindle bearing *d*, when it passes on down and lubricates this bearing. The babbitt collar or cup *g*, against which the lower end of the pulley hub runs, forms another oil chamber, which is supplied from the oiler at the side of the pulley, and it is obvious that all the running and sliding bearings are easily kept well lubricated.

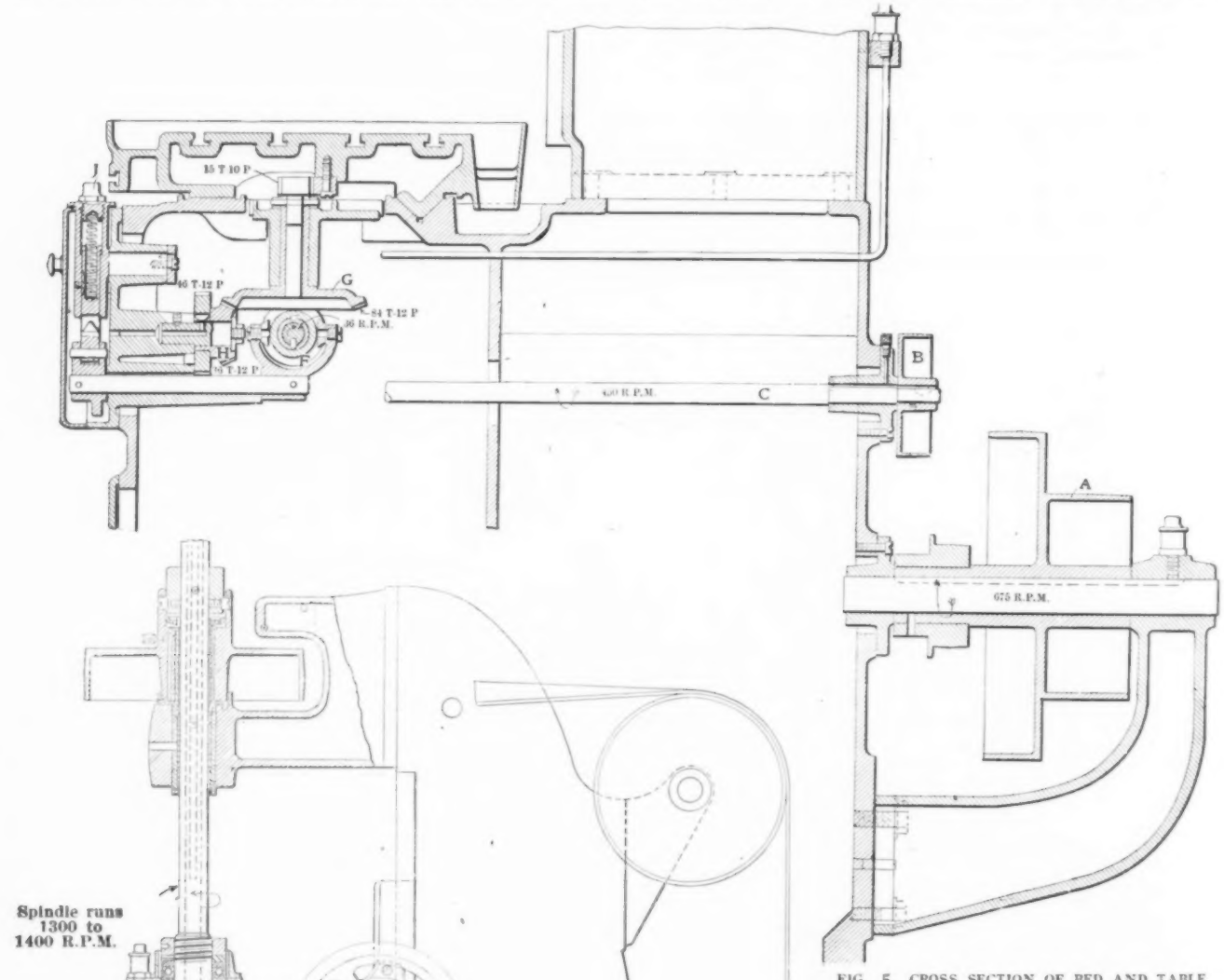


FIG. 5. CROSS SECTION OF BED AND TABLE

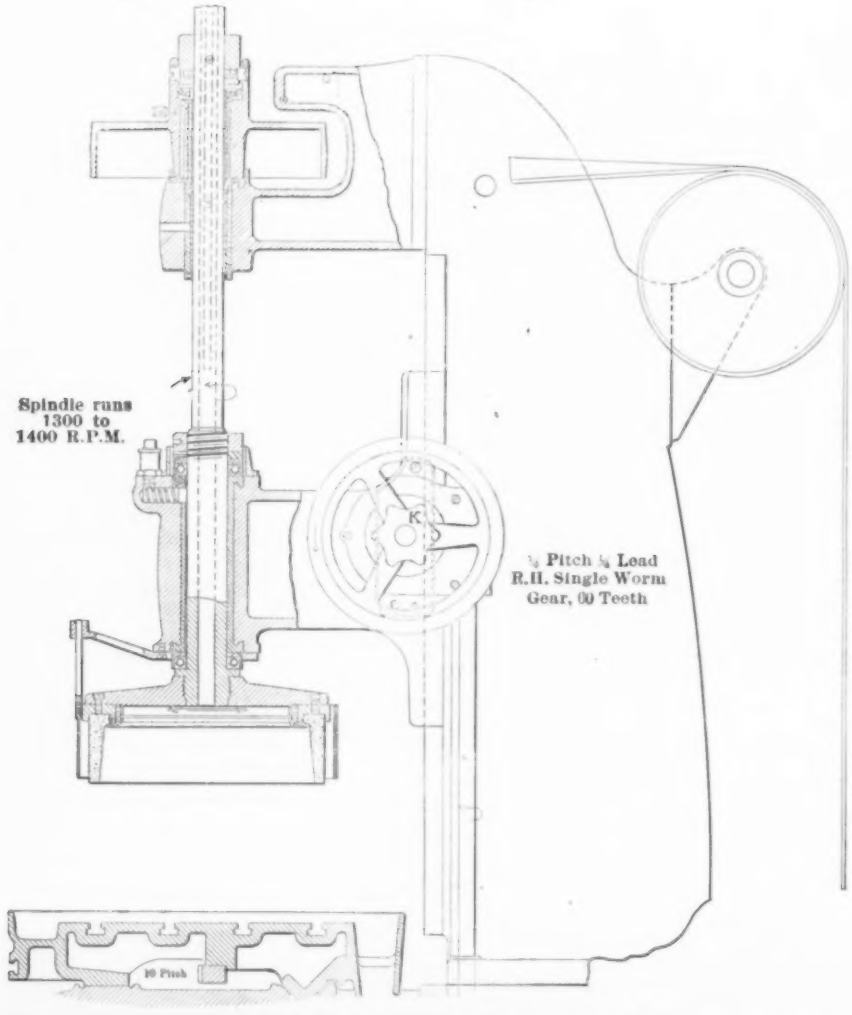


FIG. 7. SECTION THROUGH SPINDLE BEARINGS AND WHEEL

Wheel Details

Fig. 10 shows the detail of the grinding wheel, and the method of mounting it in place. The ring to which it is attached is provided with an annular groove, which is slightly dovetailed, and the wheel is set in place in shellac; the internal locking ring being attached in the manner indicated. Fig. 11 is a sectional view of a lapping wheel built up of maple with the end of the wood sections forming the edge of the wheel. This is used with fine emery and oil. The upper ends of the maple blocks

are secured in a deep channel in the binding ring, and wire is wound midway of the wheel to still further stiffen it. The emery wheels are also wound with wire in the manner shown in the half tones, Figs. 1 and 2.

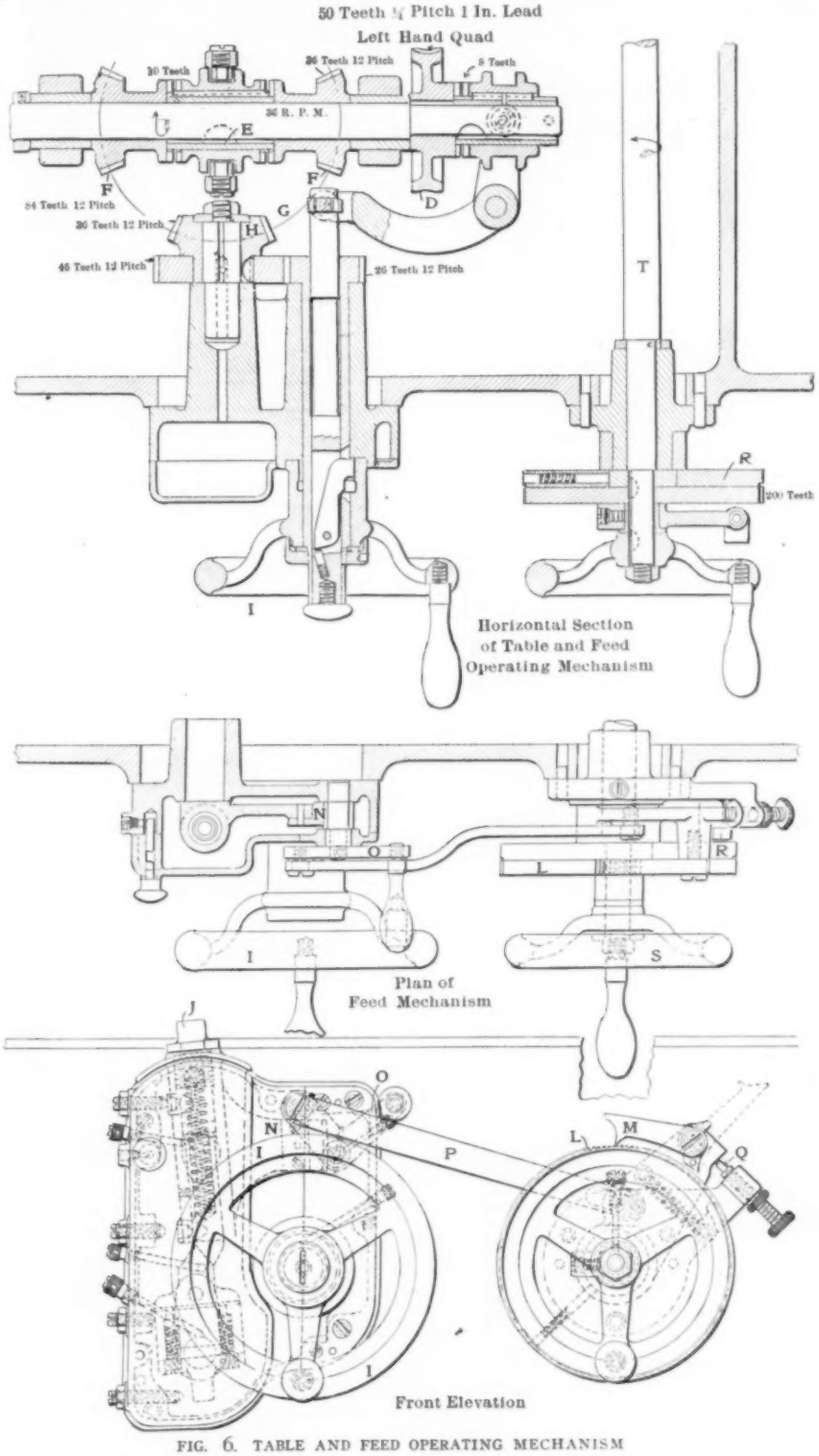


FIG. 6. TABLE AND FEED OPERATING MECHANISM

The Revolving Table

One of the important features of this grinder is the revolving table which makes possible the accurate surfacing of disks, rings, and collars from small diameters up to 16 inches in size. Where large disks are ground this table is revolved and the main table reciprocated at the same time greatly facilitating the finishing of the work. The construction of this table is shown in Fig. 12, and as will be observed, all working parts are well protected from emery and water. The drive is by means of worm and worm wheel, and the table proper as it revolves, rests upon a broad ring of babbitt metal. The vertical screw at the left-hand side may be adjusted to tilt the table when it is desired to grind disks or other work with concave or convex surfaces. The center line of the pivoting bearings upon which the table support is carried coincides with the center of the worm shaft, as will be clear upon inspection of the several views.

The bushing fitted in the circular table is adapted to receive a plug which fits the work, and which forms a means of locating the job for the grinding operation. This is the only holding device necessary for rings, disks, etc., as the friction between the table and work is sufficient to drive the latter while the emery wheel is doing the work. In handling such parts say as cylinder rings for automobiles it is not necessary to square up the work before regrinding, as the rings may be taken immediately from the cutting-off operation and readily faced as required on the revolving table.

The method of lubricating the table bearings provides for complete oiling of all parts. As the oil runs down the oblique passage drilled in the table it enters the chamber about the central stud and flows over the babbitt seat for the table, and as the chamber fills the oil rises through the passage shown, and reaches all parts of the table bearing. The ledge surrounding the babbitt ring, and the circular wall encasing the worm gearing provide for the retention of any desired quantity of oil about the important bearings, which may then be kept flooded without the lubricant working to the outside of the fixture.

Shaft *A*, Figs. 12 and 13, which drives the revolving table gearing through the medium of bevel gears, is itself driven by a belt from a shaft extending along the rear of the grinder. When the revolving table is not to be used the pin *B*, Fig. 13, is withdrawn, the inner end of the shaft *A* uncoupled from the gear shaft which rotates the table (Fig. 12), and the shaft *A* and its supporting bracket, are then swung back out of the way. Fig. 13 also shows the arrangement of the clutch for controlling the operation of the driving shaft *A*, this clutch also being a modification not represented in the half-tone illustrations.

Guards, Truing Device, Etc.

The guards with which the grinder is equipped are of telescopic construction. They are shown in Figs. 1 and 2 at the right-hand side of the machine. When thin work is being ground only one guard is necessary; for thicker work a second guard is placed on top of the other, and attached by a form of telescopic joint. The various oil holes are well protected and no water or emery can reach any slide or bearing. The cylindrical guard for the wheel is carried, as shown in Figs. 3 and 7, by three rods, which permit the guard to be readily adjusted up or down, as required. In the equipment of the machine is included a truing device for holding a diamond by means of which the edge of the wheel may be easily dressed true when necessary.

The maximum distance from the top of the revolving table to the emery wheel when new, is 6¾ inches; and from the top of the magnetic chuck, 8½ inches. The revolving table is 16 inches diameter, and the face of the magnetic chuck measures 7¼ by 30 inches. The surface of the table

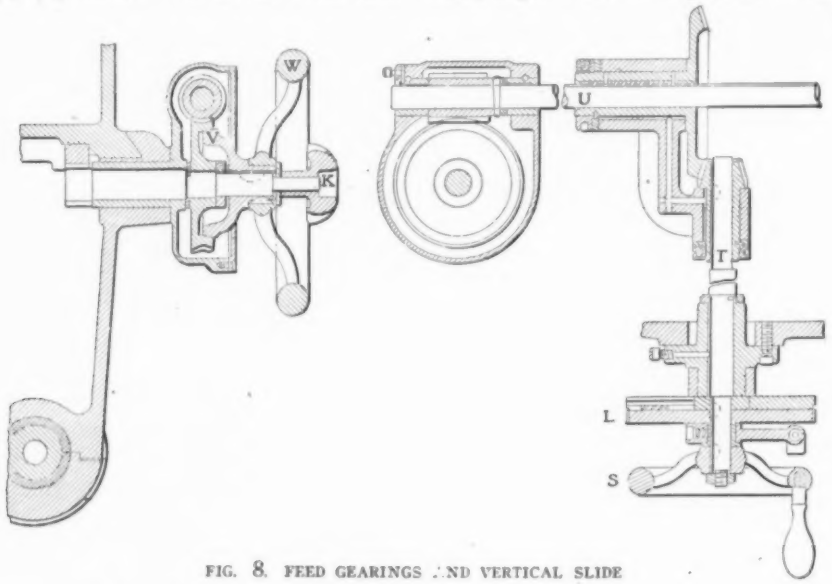


FIG. 8. FEED GEARINGS AND VERTICAL SLIDE

proper, exclusive of surrounding channels for water, is 10¾x36 inches, and work up to 10x36 inches in area, or 16 inches diameter may be ground.

The machine may be driven either by belt from a countershaft or by a 7½-horse-power constant-speed motor, the construction of the base being such as to admit of the easy attachment of a motor when desired. The machine weighs 3600 pounds.

In motorcycles, as in automobiles, the tendency toward increased number of cylinders appears to be popular. A prominent maker in Hartford, Conn., has adopted the two-cylinder engine as a standard for motorcycles. The purr of the "four" is now heard not infrequently on the roads around New York city. A three-wheeler or so-called "side-car" of foreign make, recently noticed, which was propelled by a two-cylinder engine, was furnished with a clutch, permitting of the engine's being started or left running when the vehicle is standing still.

Experiments now being conducted by the boiler division of the United States Geological Survey fuel-testing plant at St. Louis, Mo., on the nature of boiler efficiencies have suggested that stationary boilers ought to be made to do ten to twenty times as much work per unit of heating surface as they do now. This great increase in capacity is to be attained by subdividing the heating surface and water streams more finely and by allowing less restriction of the water inside the boilers and by using high forced and induced draft to put a large mass of gases through the boiler at a very high speed.

Adjusting Gages by Peening

By W. H. Booth

If a gage gets out of truth from any cause, ought it not to be possible to correct it by more mechanical means than peening it? Why should there today be any objection to the gage which is adjustable?

The reference disk is properly made solid and non-adjustable, but the reference disk has a very large surface; it possesses theoretically an unlimited number of diameters and should therefore require an infinite number of usages before it is worn below size. With reference disks and setting bars it ought to be quite possible to work with adjustable gages, and no man who will tamper with an adjustable gage would have any hesitation in tampering with a fixed gage if he wished to make an excuse for having spoiled a piece of work.

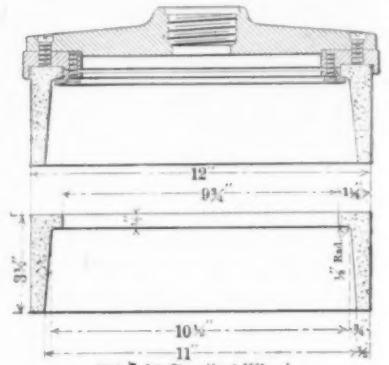


FIG. 10 Detail of Wheel

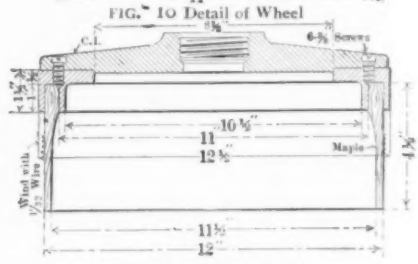


FIG. 11 Lapping Wheel

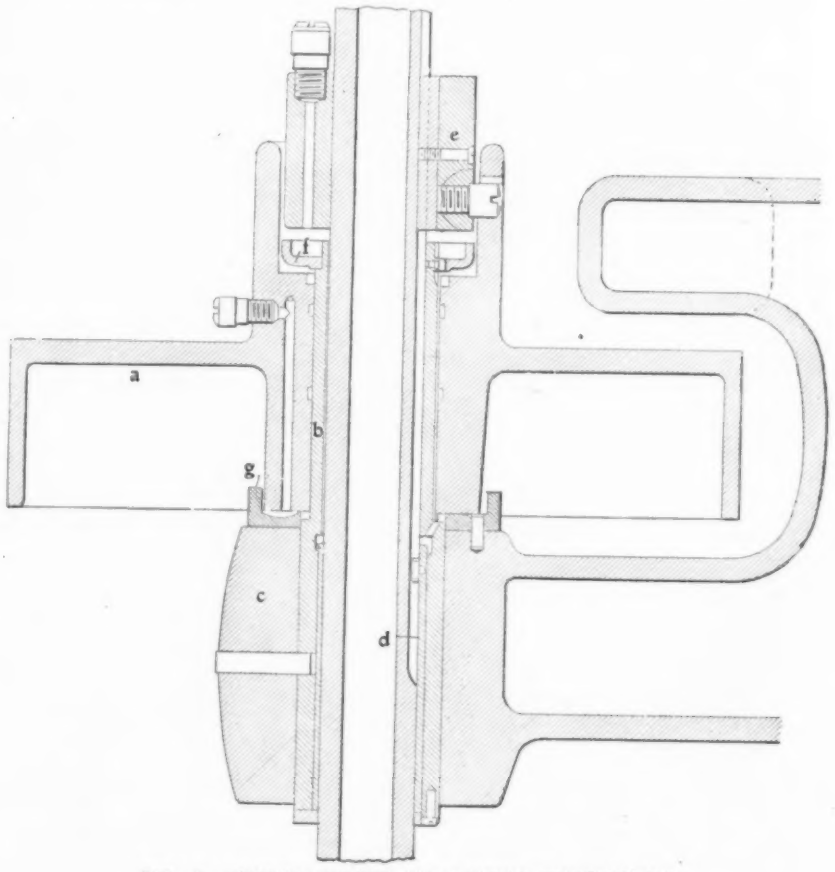


FIG. 9. SHOWING PULLEY AND BEARING CONSTRUCTION

The Expense of Gages

The greatest bar to the introduction into all workshops of a good system of limit-gage working is probably the expense of installing the gages. Assuming that there is only one set of gages for holes, since this is the cheapest system on which to work, there must be several sets of external gages for limit-gage working; for there must be the gages for the running fit, the push fit, the force fit and the drive fit, and necessarily such a complete outfit means heavy initial expense and constant maintenance and worry.

With adjustable gages, cheap little setting bars are made wherewith any gage can be set to the fit required. Since the setting device is a fine-threaded screw, and little vernier plates or disks can be provided with which to adjust the setting, a complete outfit of limit gages for any fit becomes cheap and simple. The setting-vernier disks enable any gage that has been adjusted to standard to be moved so many ten-thousandths larger or smaller by fitting the vernier upon the adjusting screw and turning it with the screw as many divisions as may be necessary, the screw acting exactly like that of a micrometer.

Effect of Peening Not Permanent

As regards peening an untrue gage into shape, certain experience seems to show that the effect of peening eventually wears off. If a surface is peened, the skin is stretched or put into stress and it forces the whole gage into different shape. The stresses induced gradually readjust themselves and the gage goes back somewhat from its stressed dimensions. In making solid gages the workmen peen through on the flat to close them, and they peen them inside the round edge of the jaw to cause them to open; the finished gage is a pair of jaws held to place by the conflicting inside and outside compressions.

Peening effects are taken more or less wholly or partially out by the file which is used to rub away the surface that has been peened and put into a condition of *surface* stress. I italicize the word surface because it is just on the surface that peening takes effect principally.

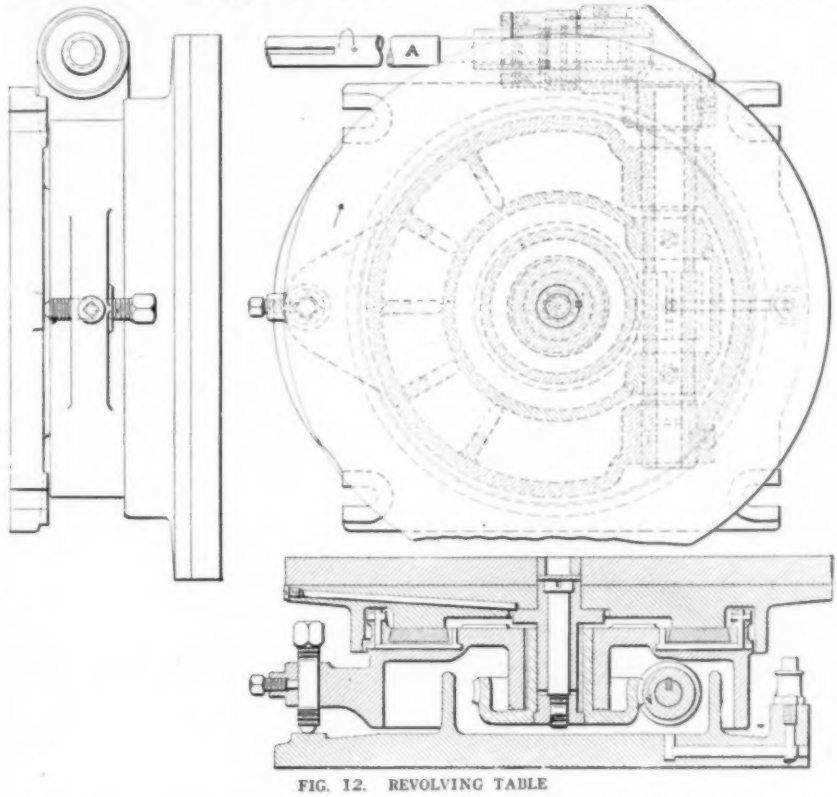


FIG. 12. REVOLVING TABLE

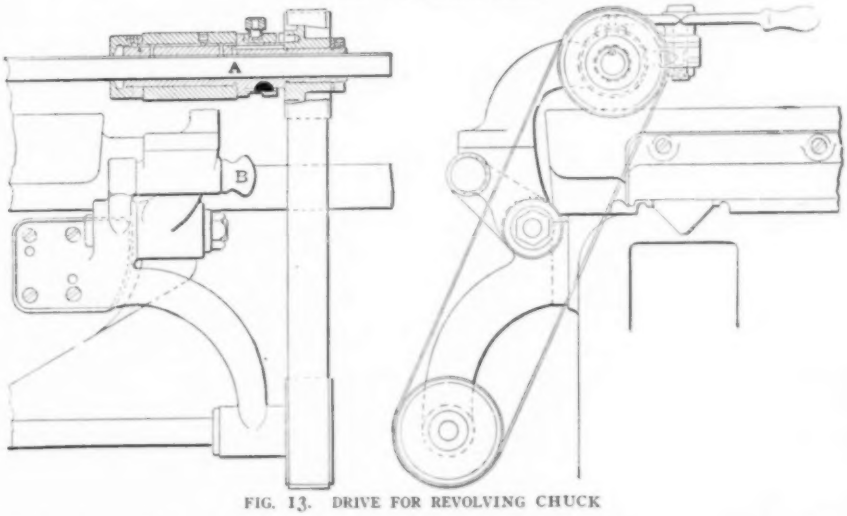


FIG. 13. DRIVE FOR REVOLVING CHUCK

The Wear of the Hands

The gage is hard painted and goes into use. For a time the hard paint stands the wear of a man's hand. Then at last it is all rubbed off and the hand wear is transferred to the surface of the metal. This is rubbed away as by a fine file. A worn or used gage bears evidence of the rough polishing effect of gritty hands. Needless to say, as the peened surface of the gage is polished off, the gage goes out of shape and ceases to do good work. How to make solid gages without peening it is difficult to say. Presumably they could be made with time and patience, but actually the peening operation is the one relied on. In the adjustable gage all stresses of construction can be eliminated by proper annealing, and no wear will affect the gage subsequently. Nor would it matter did it do so, for the gage, being adjustable, is supposed to be set for each job.

Keeping Gages Adjusted Properly

Necessarily an adjustable gage should go back to the tool room every time a job is completed, and each new job should receive its set of newly adjusted gages. With a proper system of inspection any need for further adjustment can be discovered before matters have gone too far, and there is a possible further advantage in the adjustable gage that any particular personal peculiarity in any man handling a gage can be allowed for in the adjustment. Limit gages aim to produce work for mean size. If one man tends to the lower limit, another man tends to the upper limit.

Results from Solid Gages

With solid gages these men will not turn out parts that are of the mean size which is really wanted, for one man will make too many large pieces, the other man too many small pieces. With adjustable gages a turn of the adjusting screws to the right and left, respectively, in the two cases will enable each man to produce the same parts to the same mean diameter.

In this way the limit gage may be used to correct personal tendencies without the person involved being worried about the matter. His tendency reveals itself at the inspection table, and he does not even know that he has the tendency. All he notices is that his gages are called in for adjustment, and he does not know that they are adjusted as against his own tendency. The limit-gage system thoroughly carried out may be made to produce work that varies well within the limits allowed on the gages.

Heat Treatment of Alloyed Steels

Methods of Annealing, Temperatures Which Are Safe, Ways of Heating and Quenching and Effect of Various Alloys

BY E. F. LAKE

In working the high-grade alloy steels it is very important that they be properly heat treated, as poor workmanship in this regard will produce working parts that are no better than the ordinary carbon steel, even though the stock used be the highest grade of steel that is procurable. And by improperly heat treating them it is possible to make these high-grade steels more brittle and less able to support a load or withstand the strains and stresses than the ordinary carbon steels.

Annealing Improves Alloy Steel

All of the alloy steels are improved in tensile strength, elastic limit, elongation or reduction of area by annealing, hardening or tempering them, and a general rule has been adopted that they should be annealed after each important operation, to reduce the internal strains to a minimum.

The theory of heat treatment rests upon the influence of the rate of cooling on certain molecular changes in structure occurring at different temperatures in the solid state. These changes are of two classes, critical and progressive; the former occur periodically between certain narrow temperature limits, while the latter proceed gradually with the rise in temperature, each change producing alterations in the physical characteristics. By controlling the rate of cooling, these changes can be given a permanent set, and the physical characteristics can thus be made different from those in the metal in its normal state.

Factors Which Influence Results

The results obtained are influenced by certain factors as follows: First, the original chemical and physical properties of the metal; second, the composition of the gases and other substances which come in contact with the metal in heating and cooling. Third, the time in which the temperature is raised between certain degrees, or the temperature-rise curve. Fourth, the highest temperature attained. Fifth, the length of time the metal is maintained at the highest temperature. Sixth, the time consumed in allowing the temperature to fall to atmospheric, or the temperature-drop curve.

The third and sixth are also influenced by the size and shape of the piece; by the difference in temperature between it and the heating and cooling mediums; by the thermal capacity and conductivity of the latter, each of which may vary widely within the temperature range to which it will be subjected.

The first, second, third and fourth are but elements of the heating process, and the sixth of the cooling. The method of heating the alloy steels is very important, as mechanical injuries are liable to occur, in the external layers of the metal as well as the internal, from a too rapid rise in the temperature, especially at the start.

Highest Safe Temperature

The highest temperature that it is safe to submit a steel to for heat treating is governed by the chemical composition of the steel, and this temperature should be about 40 degrees Fahrenheit above the highest point of transformation in the steel considered. Thus pure carbon steel should be raised to about 1300 degrees Fahrenheit, while some of the high-grade alloy steels may safely be raised to 1750 degrees Fahrenheit. It is necessary to raise the metal to these points so that the active cooling process will have the desired effect of checking the crystallization of the structure. If raised above these temperatures, in an oxidizing atmosphere, the surface of the piece becomes covered with a scale of iron oxide and the oxidation extends to the elements combined with the iron.

When these oxides remain within the metal, they tend to form a film of separation between the metallic grains, thus destroying the cohesion between them, and the metal is said to be burned. After burning, it cannot be brought back to its former strength without remelting. If the temperature is maintained within the crystallogenic zone, disaggregation proceeds, so that the longer it is subjected to this temperature and the higher the temperature the less homogeneous it becomes and the coarser its grain after quenching. Steel in this state is called overheated. It can be partially returned to its former strength by repeated forging above the critical temperature, followed by positive quenching.

Care Necessary with Alloy Steel

Owing to the nature of the alloyed steels they must be handled very carefully in the processes of annealing, hardening and tempering; for this reason much special apparatus has been installed in the past few years to aid in performing these operations with definite results.

This apparatus is divided into two distinct parts, that is, the apparatus for heating the metal, and that for cooling. In heating the metal four methods are used, namely, furnaces using solid fuel, liquid fuel, gaseous fuel and electricity.

Furnaces using solid fuel such as coal, coke, charcoal, etc., are the most numerous and have been used the longest. These furnaces consist of a grate to place the fuel on, an arch to reflect the heat and a plate to put the pieces on. The plate should be so arranged that the flames will not strike the pieces to be heated, and for that reason some use cast-iron or clay retorts. The doors should open and close very rapidly, so as to keep the cold air out of the furnace. The disadvantage of this style of furnace is that it is almost impossible to keep a constant temperature, and as a chimney must be provided, much heat is lost through that.

Heating in Liquids

Furnaces using liquid for heating consist of a receptacle to hold the liquid, which is heated by coal, gas or any other economical means; the liquid is kept at the highest temperature to which the piece should be heated. The piece should be heated in a furnace to about 800 degrees, after which it is immersed in the liquid bath and kept there long enough to attain its temperature and then removed to be annealed or hardened.

The bath usually consists of lead, as this is the most economical. This method gives good results, as no portion of the piece to be treated can reach a temperature above that of the liquid fuel; a pyrometer attachment will indicate exactly when the piece has arrived at that temperature, and its surface cannot be acted upon chemically. The lead can be maintained at the proper temperature easily, and the entire process is under perfect control.

Furnaces using gaseous fuel are very numerous and are constructed so they can use either natural gas, coal gas or producer gas. They are very easy to regulate and if well built are capable of maintaining a constant temperature within a wide range.

Electric Furnaces Expensive

Furnaces heated electrically are seldom used, owing to the expense of operating; but for small work, such as milling cutters, this style of furnace can be used successfully.

The cooling apparatus is divided into two classes, that is, baths for quenching and the different appliances for annealing.

The baths for quenching are composed of a large variety of materials. Some of the more commonly used are as follows, being arranged according to their inten-

sity on 0.85 per cent. carbon steel: Mercury; water with sulphuric acid added; nitrate of potassium; sal ammoniac; common salt; carbonate of lime; carbonate of magnesia; pure water; water containing soap, sugar, dextrine or alcohol; sweet milk; various oils; beef suet; tallow; wax. These baths, however, do not act under all conditions with the same relative intensity, as their conductivity and viscosity vary greatly with the temperature, and their curves of intensity are therefore very irregular and cross each other frequently.

With the exception of the oils and some of the greases, the quenching effect increases as the temperature of the bath lowers. Sperm and linseed oils, however, at all temperatures between 32 and 250 degrees act about the same as distilled water at 160 degrees.

Double Quenching Beneficial

With many of these alloy steels a dual quenching gives the best results, that is, the metal is quenched to a certain temperature in one bath and then immersed in the second one until completely cooled, or it may be cooled in the air after being quenched in the first bath. For this a lead bath, heated to the proper temperature, is sometimes used for the first quenching.

The appliances for annealing are nearly as numerous as the baths for quenching, and where a few years ago the ashes from the forge were all that were considered necessary for properly annealing a piece of steel, today many special preparations are being manufactured and sold for this purpose.

The more common materials used for annealing are powdered charcoal, charred bone, charred leather, fire clay, magnesia or refractory earth. The piece to be annealed is usually packed in a cast-iron box in some of these materials or combinations of them, the whole heated in a furnace to the proper temperature and then set aside, with the cover left on, to cool gradually to the atmospheric temperature.

For certain grades of steel these materials give good results; but for all kinds of steels and for all grades of annealing, the slow-cooling furnace no doubt gives the best satisfaction, as the temperature can be easily raised to the right point, kept there as long as necessary, and then regulated to cool down as slowly as is desired. The gas furnace is the easiest to handle and regulate.

Anneal After Each Operation

High-grade alloy steels should be annealed after every process in manufacturing which tends to throw it out of its equilibrium, such as forging, rolling and rough machining, so as to return it to its natural state of repose. It should also be annealed before quenching, case-hardening or carbonizing.

Steels that are heat treated, their surface polished, attacked with a few drops of picric acid and examined under a microscope show different constituents according to the degree of heat they have been subjected to.

Thus if the carbon content is below 0.85 per cent. in a piece which has been cooled slowly, it will show alternate layers, one of which is ferrite—or iron—and the other an iron carbide called cementite, which under certain conditions has the appearance of mother of pearl and is called pearlite. If the steel is heated to 1375 degrees Fahrenheit and quenched, it shows fine lines intersecting each other, which is martensite.

Effect of Various Heats

If heated to 2200 degrees and quenched in a very cold bath, a component is shown that is easily scratched with a needle, and this is called austenite. If quenched during its transformation or above it in a bath of little activity, such as oil, a constituent is obtained which is easily colored with the acid and appears jet black; this is called troostite. Thus in annealing, hardening and tempering steel its constituents are changed from martensite to austenite, troostite and even into pearlite.

An ordinary steel well hardened shows martensite, and if the piece is annealed slowly, a new special constituent makes its appearance, which is called sorbite; the color of this is readily darkened by picric acid, but its nature has not yet been definitely determined.

Thus these changes show that any steel can be tempered, also that its tensile strength, elastic limit, elongation and reduction of area are raised and lowered, even though some steels may be filed after tempering, which is the usual test a blacksmith gives a piece of steel to see if it is hardened.

Tables Show Wide Range of Strength

The wide range of strength given to some of the alloy steels by heat treatment is best shown by the Table No. 1. The composition of the alloy was:

	Per cent.
Nickel	2.43
Chromium	0.42
Silicon	0.26
Carbon	0.33
Manganese	0.43
Phosphorus	0.025
Sulphur	0.022

The general effect of annealing steel is to destroy martensite by producing pearlite in conjunction with ferrite or cementite, and this phenomenon comprises intermediate stages.

If the annealing takes place between 400 and 750 degrees Fahrenheit, the martensite remains, although it is slightly modified; but if the temperature is carried above the point of transformation, the structure becomes normal again. Thus in forging or hammering steel the tendency is to crush the crystals and bring the particles closer together; but as there is a limit to the density of the metal, annealing is resorted to, to relieve the strains and bring it back to its normal state.

When a given steel is heated to a temperature above the highest point of transformation, the grain assumes a definite size, and the size of the grain increases in proportion to the temperature above this point of transformation.

Keep Annealing Temperature Low

Therefore the annealing temperature should be kept as close to the point of transformation as possible, owing to the fact that the coarser the grain the more brittle the metal, and when cooled slowly the metal will retain the grain of the highest temperature to which it has been submitted.

A steel carried to 2200 degrees, or a bright orange, and cooled to 1650 degrees will show no change in the grain; but if it is cooled down to 900 degrees, which is below the point of transformation, and then re-heated to 1650 degrees, a change will be seen in the grain.

If a steel is heated to a variable temperature and slowly cooled, the mechanical properties will vary as follows:

First, the tensile strength slightly increases with the increase in temperature up to 2375 degrees, after which it rapidly decreases. This makes it necessary to keep the annealing temperature a little above, but as close to the point of transformation as possible.

Second, the elastic limit passes through a minimum at the point of transformation but increases slightly when the heat passes this point, and then decreases as this point is exceeded by 175 degrees. The slower it is cooled from the point to which it has been heated the lower will be the elastic limit.

Third, the elongation decreases as the annealing temperature increases, and this decrease is very important when the temperature attains 2375 degrees.

Heat Treatment.	Tensile Strength Lb. Per Sq.In.	Elastic Limit Lb. Per Sq.In.	Elongation in 2 In. Per Cent.
Quenched at 1550° Fahrenheit	227,000	208,000	4
Quenched at 1550° tempered at 575°	219,000	203,500	6
Quenched at 1550° tempered at 800°	195,500	150,000	8
Quenched at 1550° tempered at 925°	172,000	148,500	11
Quenched at 1550° tempered at 1025°	156,500	125,000	13
Quenched at 1550° tempered at 1125°	141,000	102,000	15
Quenched at 1550° tempered at 1550°	109,500	70,500	22

TABLE NO. 1. SHOWING EFFECT OF HEAT TREATMENT.

Care Needed for Good Results

With these points taken into consideration it will be seen that the heat treating of the high-grade alloy steels cannot be too carefully done if the best results are to be obtained.

It has been shown that if the heat treatment is carried out in a manner that will produce sorbite, the tensile strength is much higher and the elongation is slightly greater than when the metal is simply annealed. To obtain sorbite it is necessary to quench above the point of transformation and then reheat to from 575 to 1300 degrees, according to the composition of the metal and the hardness desired, then cool in air or in water. The best results in annealing are obtained by packing the pieces in boxes containing some material which will protect them against oxidation, such as magnesia. They can then be allowed to cool outside of the furnace, and if taken out of the box when the temperature has dropped to 550 degrees, there will be no danger of their air-hardening; or if a slow-cooling furnace is installed, it will give even better results, owing to the ease with which it can be handled.

Using a Salt Bath

For tempering below 900 degrees for such pieces as milling cutters, a salt bath is very practical, and the results are more certain than those obtained from many other methods. In operating this, take a mixture of salt which fuses at 575 degrees, carry it to a temperature of 750 degrees, and then plunge the piece to be tempered into it. The piece to be tempered, being cold, will solidify the salt coming in contact with it, which forms in a white crust around it; this can be readily seen through the liquid salt bath, which is very clear. The temperature of the piece increases until it reaches 575 degrees, the fusing point of the salt, and the white crust inclosing the piece disappears; then it can be withdrawn from the bath with the assurance that it arrived at the right temperature; that at which salt fuses.

Mercury is also used very successfully for quenching small tools, such as surgical instruments, and although the cooling is three times faster in water than in mercury, owing to the specific heat of mercury being much lower than water, it does not lessen the hardening effect to any great extent, and the steel is much less liable to show the surface cracks or fissures which sometimes appear when it is quenched in water.

Influence of the Bath

In hardening alloy steels the influence of the bath depends upon its temperature, its mass and its nature; or to express this in another way, upon its specific heat, its conductivity, its volatility and its viscosity. With other things equal, the lower the temperature of the bath, the quicker will the metal cool and the more pronounced will be the hardening effect. Thus water at 60 degrees will make steel harder than water at 150 degrees, and when the bath is in constant use the first piece quenched will be harder than the tenth or twentieth, owing to the rise in temperature of the bath. Therefore if uniform results are to be obtained in using a water bath, it must either be of a very large volume or kept cool by using running water, in which case the cold water should be taken in at the bottom, with an overflow at the top.

Keeping Baths Cool

Baths of oil, milk or salts can be kept cool by a jacket of running water or by a coil of pipe inside the bath, which presents a larger cooling surface than the jacket, and can be extended to the center of the liquid to be cooled.

The mass of the bath can be made small and its rise in temperature used for hardening tools that are to remain fairly soft, as, if this temperature is properly regulated, the tool will not have to be re-heated and tempered later, and cracks and fissures are not as liable to occur.

The specific heat of the bath is an important factor, as the more rapid the cooling from 1300 to 200 degrees, the more effective will be the hardening process. These are the temperatures at which the transformation which corresponds to the hardening process begins and ends.

The Effect of Conductivity

The conductivity of the bath has its effect on the exchange of heat between the piece to be hardened and the bath; therefore the greater the conductivity the more quickly the metal cools.

The volatility, or activity, of the bath influences the throwing off of the vapors which surround the piece to be quenched, when it is plunged into the bath; the quicker these vapors are thrown off, the more rapidly will the piece cool. By moving the piece around in the bath these vapors can be distributed.

The viscosity of the bath has an influence on the phenomenon of convection, which is the principal means of the exchange of heat; the higher the viscosity the less its hardening effect.

In heat treating the high-grade alloy steels the baths must be carefully selected to obtain the desired results.

Temperature and Time of Annealing

The temperature to which a piece should be raised before annealing and the length of time it should be submitted to the annealing operations, as well as the temperature at which the annealing should stop, depend, first, upon the ingredients of the metal; second, upon the size and shape of the piece; third, upon the use to which it is to be put.

Thus with the common steel, as used for ordinary purposes, it may be heated to about 1500 degrees Fahrenheit, or a cherry red, and banked in the ashes of the forge over night, or until cool; but where the piece is of an intricate shape, with thin and thick sections, the thin section will cool so much more quickly than the thick section that it will not be of an even temper. Then again, in annealing the nickel-chrome steels, they must be heated to about 1400 degrees and soaked in that heat for four or five hours, after which they are cooled by packing in charcoal in a cast-iron box, or in a slow-cooling furnace.

Influence of Ingredients

The influence of the different ingredients of alloyed steels on the results obtained under heat treatment are quite varied. Those causing injurious tendencies are the impurities which are not entirely removed by smelting or refining, such as phosphorus, sulphur, hydrogen and the metallic oxides.

Sulphur, when present in large percentages, causes a brittleness when the metal is heated, or a "hot shortness," while the other three cause a brittleness at atmospheric temperatures, or a "cold shortness." Therefore in all high-grade steels these should be kept as low as possible, not over 0.03 per cent. of phosphorus and sulphur being allowed, while many alloyed steels show these below 0.02 per cent.

Carbon and iron are the essential elements in steel. The addition of carbon to iron raises the tensile strength and elastic limit but lowers the elongation, reduction of area and resistance to shock.

Effect of Quenching

The effect of strong, positive quenching on 0.5 per cent. carbon steel, from 1400 degrees, about doubles the tensile strength and elastic limit and reduces the elongation of section to about one-tenth of its former value. The higher the carbon content the more sensitive it is to heat treatment; the more energetic the quench the more extreme will be the changes. As carbon steel is brittle, other ingredients are added to offset this, such as manganese, silicon, nickel, chromium, vanadium, etc.

Manganese, up to about 6 per cent., added to 0.25 per cent. carbon steel decreases the ductility according to the percentage of manganese. At 6 per cent. the steel is very brittle and quenching has little effect, the little it has being due to the carbon, as the manganese seems to antagonize it. For this reason it is usually combined with silicon.

Silicon neutralizes the injurious tendencies of manganese and, in quenching, it gives similar results to carbon in many ways. Steels containing from 1 to 2 per cent. of silicon and 1 per cent. of carbon are successfully used as hard tool steels. Below 1 per cent., silicon has little effect on the quenching; above 5 per cent., silicon steel is not fit for any structural pur-

poses, and without a considerable amount of manganese, silicon steel has a very low shock resistance.

Nickel Similar to Manganese

Nickel has a similar effect to manganese, but much less marked. Up to 5 per cent. of nickel, the tenacity and the elastic limit of the steel are much increased by positive quenching, especially with a high carbon content. Below 0.5 per cent. carbon and 5 per cent. nickel, the elongation is slightly decreased and the reduction of area remains the same when quenched. Beyond 0.75 per cent. carbon, 3 per cent. nickel steel becomes super-sensitive to quenching, and the formation of cracks and fissures is difficult to prevent.

Chromium becomes decisive in its action above a content of 1 per cent. It retards the development of the crystalline structure, thereby refining the grain; raises the hardening qualities and, although extreme hardness may be produced by tempering, it raises the resistance to fracture. Chromium intensifies the sensitiveness of steel to the quenching process, and in combination with nickel opposes the formation of cracks and fissures and raises the shock resistance to a very high figure when properly tempered.

Vanadium a Rival to Carbon

Vanadium rivals carbon in that it produces great changes in steel by the addition of very small amounts, as 0.2 per cent. is seldom exceeded and 0.25 per cent. very rarely. It makes steel more brittle, as it comes from the forge, than other steels, and thus should always be annealed.

When properly heat treated, vanadium steel shows as good static strengths as any steel, and its dynamic properties exceed all other steels. With 0.17 per cent. vanadium, 1 per cent. chromium, 0.25 per cent. carbon and 0.5 per cent. manganese, it makes the best of wearing gears if quenched at 1750 degrees in lard oil, then annealed at 680 degrees for one-half hour in a lead bath and cooled in air.

Quenched at 1650 degrees and annealed at 1020 degrees, then cooled in air, it makes the best of crank-shafts; annealed at 1475 degrees for one or two hours and cooled in ashes or air, it makes good connecting-rods, coupling rods or moving engine parts in general.

Vanadium Gives Wide Range of Strength

Vanadium ferrite resists the passage of carbides through steel, which makes it particularly suitable for tempering; and a wide range of static strengths can be given this steel, as shown by the following Table, No. 2 taken from the composition of metal given above:

	Tensile Strength Lb. per Sq.In.	Elastic Limit Lb. per Sq.In.	Elongation in 2 In. Per Cent.	Reduction of Area, Per Cent.
Annealed at 1475 degrees..	87,640	64,400	29	59
Annealed at 1475 degrees, oil tempered at varying quenching temperatures.	125,000	103,000	21	56
	127,800	110,100	20	58
	130,500	124,000	17	62
	138,000	127,500	18	65
	147,000	140,750	17	57
	212,000	200,000	12	51
	232,750	224,000	11	39

TABLE NO. 2

As will be seen by this table, tempering brings the elastic limit of vanadium steel up very close to the tensile strength.

Good tempering steels do not give the best results for case-hardening. A special steel, which is lower in carbon, manganese and other ingredients, is required for this, and this will be taken up at some future time.

The tempering temperature varies with the composition of the steel and with the use to which it is put, but should always be absolutely fixed. Working parts should be annealed or re-heated after each important operation in forging or machining. The temperature should never be carried more than 40 degrees past the point of transformation, and prolonged heat treatment should be avoided in annealing.

The Lewis Formula Applied to Bevel Gears

By R. Shaw

Since the introduction of the Lewis formula for the strength of spur gears it has often been quoted for bevels. However, one point which is obvious to anyone who takes the trouble to understand the formula seems to be generally neglected—namely, the variation of the tooth factor. Compare the contour of the tooth of a spur pinion and of a miter gear with equal number of teeth. It will be seen at once that the miter should have a higher tooth factor than the spur. The correction can easily be made.

The accompanying diagram shows a miter wheel of 19 teeth. The pitch radius is AB; but in the development of the tooth contour the radius of the pitch circle becomes AC. So the form of tooth of the miter with pitch radius AB is the same as that of a spur wheel with pitch radius AC. Then, to find the equivalent spur wheel the tooth factor of which will be equal to the 19-toothed miter, multiply the number of teeth by $\frac{AC}{AB}$. In this case the result is 29. Thus the tooth factor becomes 0.1 instead of 0.087, the factor for a 19-toothed spur gear.

Instead of using a formula to find the multiplier it is safer to measure AC and AB; but for those who are fond of formulas it may be stated thus:

Let

N = number of teeth of the bevel gear,

and n = number of teeth in its mating pinion.

The multiplier for the wheel =

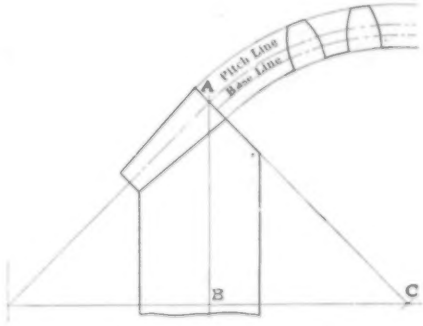
$$\frac{\sqrt{N^2 + n^2}}{n}.$$

and the multiplier for the pinion =

$$\frac{\sqrt{N^2 + n^2}}{N}.$$

In use multiply the number of teeth by their respective multipliers and take the nearest whole numbers for the spur wheels of equal tooth factor.

For the other items in the Lewis formula, the pitch should be measured, and the load taken at the middle of the tooth



A BEVEL GEAR DIAGRAM

face, but the stress taken should be in accordance with the maximum speed, that is, the speed of the large end of tooth.

M——, England.

The electric locomotive has a worthy rival as to speed in the automobile. S. F. Edge, in a six-cylinder 60-horse-power Napier motor car, made recently on the New Brooklands track 1581 miles and 1310 yards in 24 hours, at an average speed of 66 miles an hour, and reaching at times 72 miles. No man ever before traveled anything like as far, on or off tracks at such speed. The Brooklands track is 3 miles in circuit. Around the course are sentry boxes, which give full control of the complete circuit. These are equipped with telephones. In the event of an accident or a breakdown, the sentry in the nearest box hoists a flag, rings an electric bell, which communicates with the sentries on either side of him, and then telephones to headquarters in the official buildings for what help is required. A special staff, an ambulance car, and a breakdown gang are always in attendance, for despatch on telephonic call or otherwise.—*Electrical World.*

Proportions of Machine Screw Heads

Following the proportions of machine screws and taps in the last issue, the four standard heads are given herewith. These proportions are based on and include the diameter of the screw, diameter of the head, thickness of head, width and depth of slot, radius for round and fillister heads, and included angle of the flat-head screw. These appear on the following page.

Simplifying a Difficult Cam Job

Give any mechanic a blue print of the cam shown in Fig. 1, and tell him it must be made exactly like the drawing, each lobe or part of the cam having the correct shape, the right angularity with all the others and the correct projection from the center, and he could not be blamed for thinking that he was up against a hard proposition.

This was the problem that was presented to L. Wright, Jr., of Newark, N. J., in connection with a special machine he was building. The way he solved this explained why people who have particular work of any kind gravitate to this shop.

After carefully studying the problem, the solution arrived at was simplicity itself and an excellent example of practical mechanics.

The Starting Point

Starting with the keyway as a base line, six pieces of sheet zinc such as *A* and *C*, were placed together, the center hole drilled and the keyway cut in them all at the same place. Then a piece of zinc *B* was made and fastened to the drawing board with two tacks or screws. A center line was drawn through the keyway of the piece *B*, and also through all the other pieces.

Placing a sheet of the zinc over *B* to hold it in place, and give a center for the dividers, the draftsman laid off the first cam, No. 1, the same as he did on his drawing, and the cam was cut in zinc as in *A*, Fig. 2.

This was done with all the cams, No. 5 being shown at *C*, and the others being done in the same way. While the blue prints might, perhaps, have been cut out and glued to the zinc to save laying the cams out again, it was thought best not to do this, as no stretching of paper could be tolerated; for the cams must be accurate.

All the zinc cams were then carefully cut to the outlines laid out, and the first stage of the work was done.

Making the Master Cam

Then six pieces of low-carbon steel, ¼ inch thick and large enough to make the cams, were drilled, and the keyway cut the same as with the zinc. Using the zinc as a templet, the cams were scribed on the steel, and these carefully cut out to the correct outline; they were then case-hardened.

The next step was to make a mandrel *D*, Fig. 3, the size of the hole in the cam and put a key in the left end of it as long as the finished cam. Then five collars were made to space these steel cams, as shown at *C*, Fig. 3. The collars and cams, with proper means for holding at the ends and assembled, as shown, made a complete skeleton cam that was exactly like the drawing so far as its action was concerned.

The Blank and the Milling Cutter

The blank for the cam itself was a piece of round steel large enough to make all the lobes of the cam and long enough to allow a projection *E* to be turned on it. The blank was then bored and a keyway cut in the end *E* only, while the shaft was milled for a small Woodruff key at this point. A set screw, as shown, held the blank in place on the key, and the work was ready to mill.

In the lathe the bar *B* was driven between centers; it carries the milling cutter *M* securely keyed to it. This milling cutter has the flat face of the right width to mill the face of one of the cams, shown dotted in *F*, Fig. 3, and with the correct angles for the slopes, as, when fed down on the cam 3 or 4, it mills the face of cam 3 and the slope of cam 2 on one side and the slope of cam 4 on the other, so the angles have to be right.

Guiding the Milling Cutter

Mounted on *B*, between the collars shown is the roll *A*, which runs freely on the shaft, and is moved to the different positions according to the cam to be cut.

The shaft *D* is carried in a holder or fixture attached to the cross slide of the lathe carriage.

In taking the first cut the wheel *A* does not, of course, follow the cam closely, as it would make altogether too much of a cut when it reached the low part of the cam. So it is fed in a little at a time until the wheel can follow all the way and the cam be finished to size.

The bar *D*, with the work and the formers, is mounted on a fixture fastened to the carriage of the lathe and turned by a flexibly-jointed shaft from the headstock gearing. It is fed against the cutter by a weight at the back, with suitable stops to prevent its following the former entirely on the earlier cuts. Another way would have been to use wheels *A*, of varying diameters, until the work was done. A large wheel at first for the preliminary cuts, and then smaller wheels as it came down nearer to size would have been one way of doing it. Each cam would have been gone over with each wheel, so as to make but one change of wheels. This principle ought to find many applications in reducing the cost of special cams.

F. H. C.

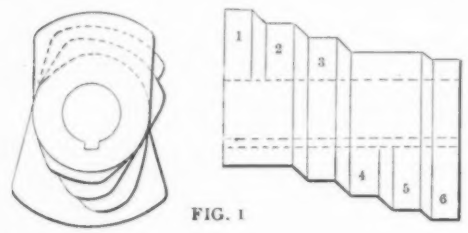


FIG. 1

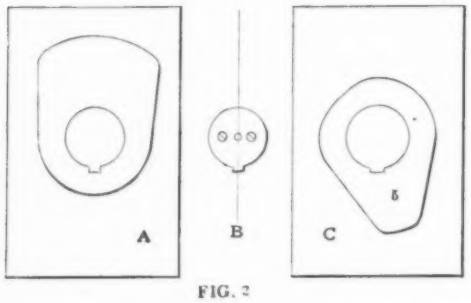
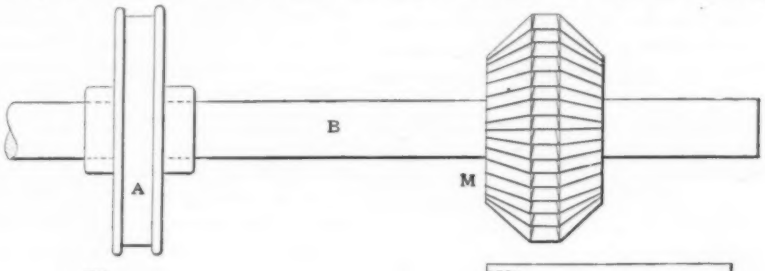


FIG. 2



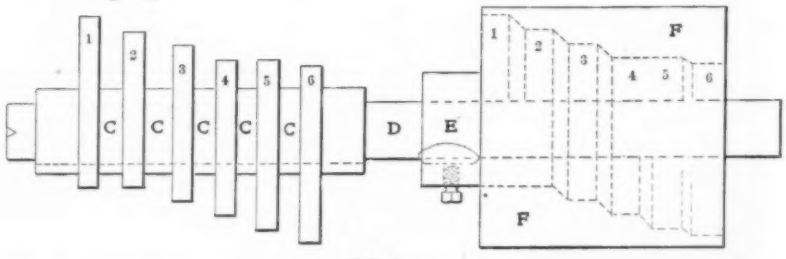
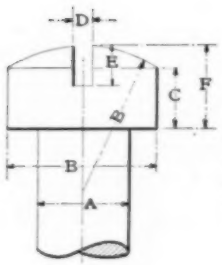


FIG. 3

THE SIX-THROW CAM AND HOW IT WAS MADE

OVAL FILLISTER HEAD SCREWS

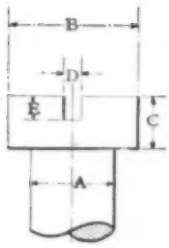
A = Diameter of Body
B = 1.64A−.009 = Diam. of Head and Rad. for Oval
C = 0.66A−.002 = Height of Side
D = 1.73 +.015 = Width of Slot
E = ½ F = Depth of Slot
F = .134 B+C = Height of Head



A	B	C	D	E	F
.060	.0894	.0376	.025	.025	.0498
.073	.1107	.0461	.028	.030	.0609
.086	.132	.0548	.030	.036	.0725
.099	.153	.0633	.032	.042	.0838
.112	.1747	.0719	.034	.048	.0953
.125	.196	.0805	.037	.053	.1068
.138	.217	.089	.039	.059	.1180
.151	.2386	.0976	.041	.065	.1296
.164	.2599	.1062	.043	.071	.1410
.177	.2813	.1148	.046	.076	.1524
.190	.3026	.1234	.048	.082	.1639
.216	.3452	.1405	.052	.093	.1868
.242	.3879	.1577	.057	.105	.2097
.268	.4305	.1748	.061	.116	.2325
.294	.4731	.192	.066	.128	.2554
.320	.5158	.2092	.070	.140	.2783
.346	.5584	.2263	.075	.150	.3011
.372	.601	.2435	.079	.162	.3240
.398	.6437	.2606	.084	.173	.3469
.424	.6863	.2778	.088	.185	.3698
.450	.727	.295	.093	201	.4024

FLAT FILLISTER HEAD SCREWS

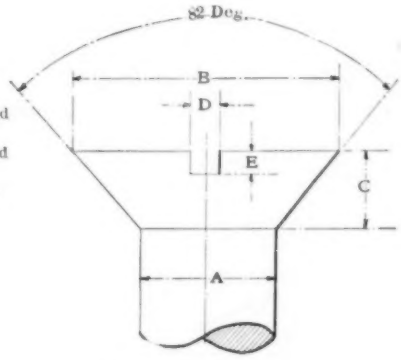
A = Diam. of Body
B = 1.64A − .009 = Diam. of Head
C = 0.66A − .002 = Height of Head
D = 0.173A+.015 = Width of Slot
E = ½C = Depth of Slot



A	B	C	D	E
.060	.0894	.0376	.025	.019
.073	.1107	.0461	.028	.023
.086	.132	.0548	.030	.027
.099	.153	.0633	.032	.032
.112	.1747	.0719	.034	.036
.125	.196	.0805	.037	.040
.138	.217	.0890	.039	.044
.151	.2386	.0976	.041	.049
.164	.2599	.1062	.043	.053
.177	.2813	.1148	.046	.057
.190	.3026	.1234	.048	.002
.216	.3452	.1405	.052	.070
.242	.3879	.1577	.057	.079
.268	.4305	.1748	.061	.087
.294	.4731	.1920	.066	.096
.320	.5158	.2092	.070	.104
.346	.5584	.2263	.075	.113
.372	.601	.2435	.079	.122
.398	.6437	.2606	.084	.130
.424	.6863	.2778	.088	.139
.450	.727	.295	.093	.147

FLAT HEAD SCREWS

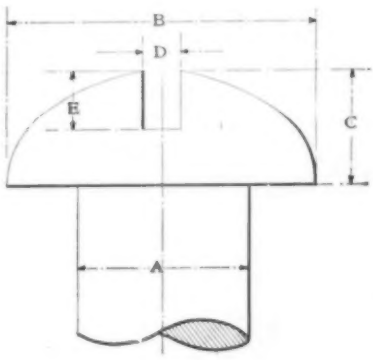
A = Diameter of Body
B = 2A−.008 = Diameter of Head
$C = A - \frac{.008}{1.730}$ = Thickness of Head
D = .173 +.015 = Width of Slot
E = ½C = Depth of Slot



A	B	C	D	E
.060	.112	.029	.025	.010
.073	.138	.037	.028	.012
.086	.164	.045	.030	.015
.099	.190	.052	.032	.017
.112	.216	.060	.034	.020
.125	.242	.067	.037	.022
.138	.262	.075	.039	.025
.151	.294	.082	.041	.027
.164	.320	.090	.043	.030
.177	.346	.097	.046	.032
.190	.372	.105	.048	.035
.216	.424	.120	.052	.040
.242	.472	.135	.057	.045
.268	.528	.150	.061	.050
.294	.580	.164	.066	.055
.320	.632	.179	.070	.060
.346	.682	.194	.075	.065
.372	.732	.209	.079	.070
.398	.788	.224	.084	.075
.424	.840	.239	.088	.080
.450	.892	.254	.093	.085

ROUND HEAD SCREWS

A = Diam. of Body
B = 1.85A − .005 = Diam. of Head
C = .7A = Height of Head
D = 1.73A + .015 = Width of Slot
E = ½C + .01 = Depth of Slot



A	B	C	D	E
.060	.106	.042	.025	.031
.073	.130	.051	.028	.035
.086	.154	.060	.030	.040
.099	.178	.069	.032	.044
.112	.202	.078	.034	.049
.125	.226	.087	.037	.053
.138	.250	.096	.039	.058
.151	.274	.105	.041	.062
.164	.298	.114	.043	.067
.177	.322	.123	.046	.071
.190	.346	.133	.048	.076
.216	.394	.151	.052	.085
.242	.443	.169	.057	.094
.268	.491	.187	.061	.103
.294	.539	.205	.066	.112
.320	.587	.224	.070	.122
.346	.635	.242	.075	.131
.372	.683	.260	.079	.140
.398	.731	.278	.084	.149
.424	.779	.296	.088	.158
.450	.827	.315	.093	.167

STANDARD PROPORTIONS OF MACHINE SCREW HEADS

Fixing Premium Rates Discussed

Old Methods Condemned as Unsatisfactory, a New One Suggested Based on Minimum Total Cost and No Limit to Possible Earnings

BY FORREST R. CARDULLO

I note at page 923, of Part 1, a most interesting letter concerning the problem of fixing the proper time allowance for work done in a shop using the premium plan. Before we discuss the question there at issue, it will be well to review the different methods by which a piece-work or a premium-work rate is set. So far as I am aware, there are two methods in general use for setting such a rate, neither of which in my opinion is the right one. The first is the one briefly outlined in the letter of your correspondent, namely, that of finding the time required by several industrious and experienced mechanics to do the job in question, and from the result, to determine either the price per piece or the proper time allowance, according as the method of payment proposed is by the piece-work or the premium system.

In fixing the rate by this method, it must be borne in mind that the tendency of such a system is to attract to each job, by a process of natural selection, the men who are best fitted to perform that class of work, and who will therefore make the largest wages when engaged in it. The probabilities are that a man working for a piece-work or premium rate will increase his output very nearly 50 per cent. when working with the same tools and methods as he uses in day work. The chances are that he will perfect the tools and methods in no small degree, if there is sufficient incentive in the way of premium, and increase his productiveness even more than this. I would say therefore that the rate ought to be such that if the productiveness of the workman were 50 per cent. in excess of the best day record, the wages earned would be not less than 25 per cent. in excess of the day rate regularly paid to the class of help employed on work of similar character.

Another Method and its Objections

The second method of fixing a rate is to set it either arbitrarily or by some such method as I have already outlined, and subsequently to adjust it until the workmen employed shall earn a maximum wage of from 10 per cent. to 50 per cent. in excess of the current day-work rate of men employed at a similar class of work. This seems to be the method which the superintendent described by your correspondent deems preferable.

The objection to this method of fixing a rate is that the cuts which are generally involved in the adjustment make it exceedingly distasteful to the men. In order to prevent such a cut, they voluntarily limit their output, and any advantage which this system of rate setting, or for that matter which the piece-work or premium system in general has, very soon disappears.

The third method of fixing the rate, and the one which in my opinion is the correct one, is to make the rate such that the total cost of the piece will be a minimum, provided only that the required grade of labor can be obtained for that rate. In other words, the rate must be at the very least, high enough so that the daily earnings of each man will be in excess of the current day rate for the class of help employed. This method, like the second, involves a revision of the rate until the proper value is found. However, while an adjustment in the case of the second method invariably means a reduction in the rate, in the case of the third method it generally, although not invariably, involves a raising of the rate.

Elements of Total Cost.

There are other elements entering into the total cost of a finished article than that of direct labor alone. Some of these elements of cost, as for instance that of material, are very nearly proportional to the output, and are therefore constant for each piece. Other items of cost, as for instance heat, light, comforts, rent of tools and buildings, etc., are proportional not to the output, but to the number of men employed. Anything which increases the output without correspondingly increasing the number of employees will therefore reduce these items of cost for each piece. Since an increase in the rate will always result in an increase in the number of pieces produced in a given time (unless the men fear a cut, or union rules oblige them to limit their output), it follows that the proper rate will always be higher than that which will make the direct labor cost per piece a minimum.

Thus it will be seen that the cost of a given operation may be divided into three items: First, the cost of the supplies necessary to carry on the work and used up in its prosecution, as for instance the draftsman's ink, or the molder's graphite. The amount of such material used will be the same for each piece turned out, in the long run, and will not vary whether the work is done rapidly or slowly, or whether it is done by a man receiving 20 cents or 30 cents an hour. The second item of cost is that of direct labor. This item will not be constant per piece, except in the case of a straight piece-work system. In the case of the premium system, the cost of direct labor per piece invariably decreases with an increase of the wages earned by the workman. The third element of cost is the "burden", comprising those items already enumerated as being proportional to the number of men employed. The amount of this burden which may be apportioned to the cost of each piece is inversely proportional to the output per man.

Figuring out the Costs

These facts may be expressed algebraically by the formula

$$C = K + R + \frac{B}{N},$$

where C is the cost per piece, K is the cost of the material used up in the making of the piece, R is the labor cost per piece, B is the burden per employee, and N is the number of pieces per man per day. Table I shows the effect of changing the piece rate on the cost of a piece, and the same thing holds true in the case of a change in the time allowance in the premium system.

Piece Rate. R.	Pieces per Day. N.	Daily Earnings.	Cost per Piece for Different Burdens, Allowing K = 1 cent.			
			B = 1.00	B = 2.00	B = 4.00	B = 8.00
10c.	20	$2.00	16.00	21.0	31.0	51.0
11c.	22	$2.42	16.55	21.1	30.2	48.4
12c.	23	$2.76	17.35	21.7	30.4	47.8

TABLE I.

If the piece manufactured is such that only unskilled labor is necessary for its production, then the best rate for a burden per employee of $2 per day, or less, is 10 cents per piece. If, however, the work requires skilled labor, such men cannot be found who will do piece-work for so low a rate, and we are compelled to fix the rate at a higher figure. When the burden is large, however, as would be the case when expensive machinery was used, the higher piece rate is seen to give the lower cost per piece, and should therefore be paid, no matter if "cheap help" is capable of doing the job.

How It Works out

The premium plan amounts to a proposition to pay a man a certain piece rate for a given number of pieces per day, and a certain fraction of that rate for each

piece in excess of the given number. In the case described by your correspondent, the rate was to be $2.40 per piece for the first five pieces produced in a week of 60 hours, and 80 cents for each piece subsequently produced in that time. The fact that the amount of the man's earnings is gotten at by a much more laborious and complicated calculation does not alter the facts in the case. A change in the time allowance changes the rate on all the pieces. A change in the proportion of saved time paid for changes the rate on the excess pieces only.

The problem is, then, to fix the time allowance and the proportion of saved time paid for, at such a point as will produce the piece for the least total cost. In doing so, it will be best to fix the time allowance at the minimum which will permit all the workers necessarily employed to earn a premium. If they cannot do so, or if they feel that the premium which they can earn is too small to be worth the effort required, the plan fails of producing the desired result. In fixing the fraction of the original which it is best to pay as a premium, it must be borne in mind that it should be great enough to be effective in obtaining its object, and will therefore be greater than that proportion which would make the labor cost a minimum. If the time allowance has been properly set, the proportion of saved time paid for should not be less than one-third, and probably one-half would in general produce better results in the matter of the total cost per piece.

Error in Fixing Time Limit

In the case given us, there is an essential error in the plan by which the time limit is computed for the different employees. It lies in the assumption that the quantity of work which each will be able to perform in a given time is proportional to the day rate paid him. The fact that A receives 30 cents per hour as a day rate, while B receives but 20 cents, does not infer that A will do his work in two-thirds of the time that B takes, but merely that A is able to do a certain class of work which B is unable to do at all, or at least unable to do well. And if A can work so much faster than B, it does not follow that the method outlined is the correct one for an equalization of rate.

Let us suppose that the time allowance for a given lot of work is 60 hours, on a 20-cent basis. Then the time allowance for A is 40 hours, and for B 60 hours. After some experience, A is able to do the work in 20 hours, and B in 30 hours. The time saved by A is 20 hours, and by B 30 hours. For this work, A receives pay for 20 hours at 30 cents, and for one-third of 20 hours saved at 30 cents, or $8 altogether. B receives pay for 30 hours at 20 cents, and for one-third of 30 hours saved at 20 cents, or $7. For the same amount of work, he receives 12½ per cent. less pay. Had he done his work in the same time as A, he would have received 16 2/3 per cent. less pay.

The only way to make the rate equitable is to pay each man for all the time he saves (which is practically a straight piece-work system), or else to put them all on a 20-cent basis, and guarantee A that his earnings shall be at least 30 cents per hour. If he cannot then earn sufficient premium to make his hourly rate 30 cents, either he is not at the proper job, or he is not a 30-cent man.

Examining the performances of the various men as recorded in your correspondent's letter, they may be tabulated as in Table 2.

What the Table Shows.

An inspection of the table discloses the fact that either the first man is receiving too high a rate, or else he has no business doing the work to which he has been assigned, for he takes more time than any of the others, no matter what their rate. The average time per piece taken by the second and third men is 5.35 hours, and the average wages earned are 31.14 cents per hour, an excess over their stated rate of 32½ per cent. The third man is an exception, and it is no more just to fix the rate by his abilities than it would be to fix it by the time made by the first man. If we do fix it in that way, the premiums earned by B and C will not be sufficient to induce them to put forth their best efforts; as a consequence, the average cost per piece will become higher. I am inclined to believe that the best thing to do would be to make the time allowance 8 hours, at 25 cents, and to pay the men for half the time saved. Such a course would inevitably result in increased earnings for the men and in a decreased cost per piece for the company, on account of the probable increased output per man.

	Time Taken.	Time Allowed.	Time Saved.	Rate.	Hourly Earnings.	Labor Cost per Piece.
A.....	7.91 hr.	8.0 hr.	0.09 hr.	30c.	30.11	2.38
B.....	6.375 hr.	10.8 hr.	4.425 hr.	22c.	27.08	1.725
C.....	4.325 hr.	9.6 hr.	5.275 hr.	25c.	35.20	1.485
D.....	3.100 hr.	10.0 hr.	6.90 hr.	24c.	41.80	1.295

TABLE 2.

It is difficult to bear patiently with the moss-back who thinks that there should be a limit to the wages of an intelligent mechanic, other than the limit set by competition and his own industry and ability. The reason that the premium plan is generally preferred to a straight piece-work plan is that an error in the fixing of the time allowance does not affect so seriously the wages earned. It is not because the workman's wages are limited to a more reasonable amount. From the standpoint of the employer, it would be better to make the rate per piece increase, rather than decrease, with an increase in the number of pieces per day that each man turns out, for by so doing the cost per piece would be brought to a minimum. If such a plan is to be adopted, however, it is necessary that the time required for a given operation be known with very great accuracy, and that the burden per man be carefully determined.

A Suggestion for Special Cases

For those cases where the time allowance cannot be fixed with any degree of satisfaction, I would suggest the following plan as preferable possibly to the regular premium plan. First, by a reliable cost system, find the least time required to make a given piece by day work. The employee is allowed that time in which to do the work. If he does it in that time, he receives the agreed daily rate, and no more. Should he do it in less time, he is paid for the time actually spent, plus a fraction of that time found by multiplying the time spent by the time saved, and dividing by the time allowed. Thus, suppose the time allowance to be 12 hours, the time taken to be 6 hours, and the rate to be 25 cents an hour. Then the time saved will be 6 hours, the time paid for will be

$$6 + \frac{6 \times 6}{12}$$

hours, or 9 hours, and the actual wage rate will be 37½ cents per hour. No matter how much the time allowance may have been overestimated, the men's wages will never be double their stated rate.

I do not wish to be understood as favoring such a scheme; but it may be found to be the best one possible in the case of untried designs, when there are not at hand sufficient data to estimate closely the proper time allowance. A year or so of running with some such scheme as this will furnish a close estimate on the proper time allowance for a premium system, when sufficient experience has been had with the premium plan, and designs are thoroughly standardized, we are in position to make a just estimate of the proper piece-work rate. I am of the opinion that a flat piece-work system is the only rational method of paying labor, when it is possible to standardize the work properly.

A "hickey" is used for bending conduit for electrical wiring. It may be made by screwing a 1-inch iron tee on to a 3-foot piece of 1-inch iron pipe, the latter serving as a lever or handle; the conduit to be bent is passed through the tee, the latter being shifted to distribute the curvature along the conduit.

A Device for Transmitting Power between Two Inclined Shafts by Means of a Straight Belt

By the device here described, power may be transmitted from a revolving shaft to another shaft at an angle with it by means of a belt without any twist in it, and without the use of idlers, mule pulleys, or such devices. It is shown by three illustrations, for which we are indebted to *La Genie Civil*, which in turn derived its information from the *Praktische Maschinen-Konstrukteur*. Fig. 1 is a longitudinal section through one of the shafts, showing the three principal parts of the device, namely, the fixed bearing *c*, the pulley *b* and the ball *a*, which is fixed on the shaft by key, set-screw or other suitable means. The bearing *c*, which, it goes without saying, is split, has formed in each half a hemispherical cavity conforming to the ball *a*. There is left, however, between the halves an opening following a great circle of the sphere, this opening being bounded by two plane faces parallel to a meridian plane; running between them, and held in position by them, is the hub of the pulley *b*. The meridian plane about which this interval or slot is symmetrical, intersects the axis of the shaft at an angle depending upon the angle between the two shafts to be belted together; it is evident that, if the angle between the shafts be θ degrees, the angle first mentioned will be equal to $\frac{180 - \theta}{2}$ degrees. The hub of the pulley *b*, which fits on the outside of the ball *a*, is divided on its central meridian plane, the loose ring being bolted to the pulley.

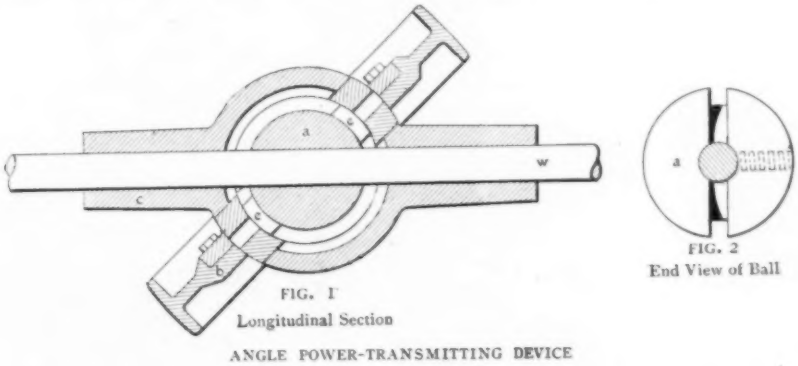


FIG. 1
Longitudinal Section

FIG. 2
End View of Ball

ANGLE POWER-TRANSMITTING DEVICE

Following a great circle of the ball *a* there is a groove in its surface, plainly shown in the end view, Fig. 2. On opposite sides of this groove work drivers *e*, the inner portions of which are flattened to fit the groove, and the outer portions are turned to fit radial sockets formed in the interior of the split hub of the pulley *b*.

The operation of the device will now be readily perceived. The shaft and the ball rotate on the axis of the former, and the pulley rotates in its own plane, fixed by the inclination of the opening between the bearing parts *c*; the drivers *e* remain in the plane of the pulley, since they are in engagement with its hub, while they are compelled to revolve by the pressure of the sides of the groove in the ball *a*, meanwhile sliding back and forth in an arc along this groove, the measure of their extreme movement during a revolution being equal to the angle θ between the two shafts previously referred to, it being understood that the angles made by the two pulleys with their respective shafts are equal to one another.

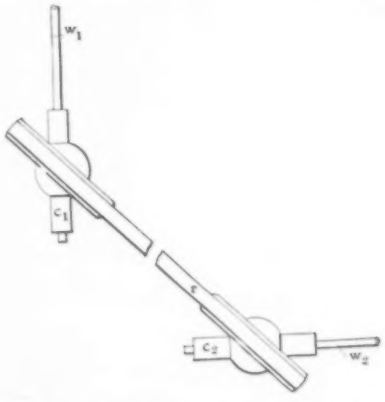


FIG. 3. TRANSMISSION BY BELT BETWEEN TWO SHAFTS AT RIGHT ANGLES

The Question of Uniformity of Velocity Ratio

As regards the uniformity of motion attained by this device, we translate the following from *Le Genie Civil*:

This angle transmission does not give equal speeds for the two shafts, unless the two pulleys, of equal diameters, are symmetrically inclined in relation to their shafts. In all other cases—supposing that the movement of the driving shaft is uniform—the speed of the driven shaft is variable, and the variations of this speed, during a revolution, are all the greater as the angle between the two shafts becomes greater. The same may be said of the forces transmitted by the pulleys.

In practice this transmission gives, it appears, good results at all speeds for angles between the shafts less than 45 degrees. When this angle is between 45 and 90 degrees, the device is still utilizable when the efficiency of the transmission is of but small importance, but the friction between the drivers *e* and the ball *a* absorbs considerable energy.

Fig. 3 represents schematically a transmission, according to this system, between two shafts w_1 and w_2 at right angles to one another. As may be seen, the pulleys, which are placed symmetrically on the shafts, make with the latter angles of 45 degrees, and the two sides of the belt are situated in the median plane common to the two pulleys.

Permanence of Gages

Editorial Correspondence

There was a time in some machine-shop life, and not so very long ago either, when a reamer was a reamer, a tap was a tap, and a gage a gage. If the reamer, tap or gage was accurate when first purchased or made, it was accurate for life, no matter what use or treatment it might have received. This time-honored belief in the eternal permanence of such things has, however, been shattered.

One interesting room in the East Pittsburg factory of the Westinghouse Electric and Manufacturing Company shows clearly that the permanence of gages is something which they have found does not exist. This room is equipped with two Pratt & Whitney measuring engines, a long vernier for pin gages and the like, and a large quantity of smaller measuring instruments, master sizers, standards and so on. To this room every gage which is returned from the manufacturing department is sent for inspection, whether it has been in the shop a few hours or several weeks. It is carefully tested and if found to be correct is sent to the tool-storage room; if wrong, it is sent to the proper department for repairs.

The permanent accuracy of their gages is surely well cared for by this detail of tool-room system. L. P. A.

In a paper presented recently before the British Institution of Civil Engineers, by Messrs. H. R. J. Burstall and J. S. Highfield, the authors in referring to alternating-current generators, say: "We wish to express the opinion that at present it is impossible to construct a machine with closed slots which will work at a pressure of 10,000 volts to earth."—*Electrical World*.

Glacier ice is now delivered to some of the larger consumers of Lyons and other cities of Europe. There are so many railways in the Alps at present that it has been found profitable to gather this ice and transport it to the cities, where it is preferred to other ice because of its hardness and lasting qualities. This ice is blasted and mined in the same manner as stone is quarried.—*The Engineer*.

A Handy Milling Machine

This has several features not found in milling machines of its class and while it is a hand- or lever-fed machine, it is intended not only to do the light work usually done on hand-fed machines, but to do accurately and more quickly much of the work usually done on a shaper, on larger and more expensive power-fed milling machines, on the profiler and on the cam-cutting machines.

With carbon-steel cutters, when the tooth contact was comparatively slow, power feeds were required to get the slow steady feeds necessary to produce true, smooth surfaces; but with high-speed steel milling cutters, with the tooth contact nearly quadrupled, the surface produced by hand-fed mechanism is satisfactory and the rapidity of operation, particularly on short cuts, greatly increased.

This has quick-change features which make it an excellent short-job machine, while its rigidity and absence of chatter make it a rapid-production manufacturing machine on work entirely beyond the range of many hand-milling machines.

Instead of following the common practice of providing the vertical and transverse adjustments, by interposing double or treble sliding elements between the work table and the column of the milling machine, this table hangs and slides upon a vertical rail and there is but one slide between the table and the column. This insures stiffness and rigidity.

The table has an inclined bearing surface of 1½x23½ inches running the entire length of the table and two vertical surfaces 1½x23½ inches also the entire length of the table. This feature is claimed to be conducive to the least lateral lost motion and liability to chatter that it is possible to secure in a freely moving slide.

The weight of the table and all upon it tends to hold the sliding surfaces in constant contact. The table has a finished or working surface of 8x18 inches, unusually wide to accommodate bulky work and to give wide transverse range of adjustment to chucks and vises.

The spindle head is counterbalanced by weights in the column. Part of these weights, like scale weights, may be removed so the weight of the head will feed the cutter down into the work by gravity, or additional weight may be added so the cutter will feed up, the weights being heavier than the head. The vertical movement of 12 inches is provided.

As both the vertical and transverse feed of the cutter are independent of the table, or the weight of the work upon the table, small cutters may be sensitively fed both in and down, without danger of breaking cutters. The drive of the spindle is by a 4-inch belt from the swinging cone pulley shaft and by a 2½-inch belt from the cone on swinging shaft to the countershaft. A distance rod with adjusting turn buckle holds the swinging cone pulley shaft in position to keep the spindle belt taut in all positions of the head. This is a decided improvement over the old machines with a head that adjusted vertically as these were always weak in belt power and very unsatisfactory.

Six spindle speeds are obtained by means of the three-step cone pulleys and two clutch pulleys on countershaft. Adjustable stops are provided for all slide movements to limit the travel in both directions.

The spindle is 1-15/16 inches diameter, 18 inches long, of forged crucible steel, and is hollow its entire length. It has a No. 9 Brown & Sharpe taper hole, and a rod with weighted head is secured in the spindle for quickly removing arbors. The spindle bearings are bronze and tapered, the forward bearing being 2½ inches diameter, 3 inches long, and the rear bearings 2⅜ inches diameter, 2¼ inches long. Provision is made for a quick and sensitive adjustment of the spindle bearings in the quill.

The quill supporting the spindle is 2-15/16 inches diameter, and has a longitudinal movement of 2½ inches by rack and pinion. The overhanging arm is straight throughout, and may be slid out of the way when not needed. The pendant is provided with a center controlled by thumbscrew to steady long arbors. A cam-cutting guide pin may be secured in the other end of pendant. The countershaft has two clutch pulleys 8 inches in diameter, 5 inches face, and should run at 100 and 175 for spindle speed from 70 to 250.

The vise furnished with the machine has jaws 6 inches wide, 2 inches deep and opens 3 inches without reversing. By re-

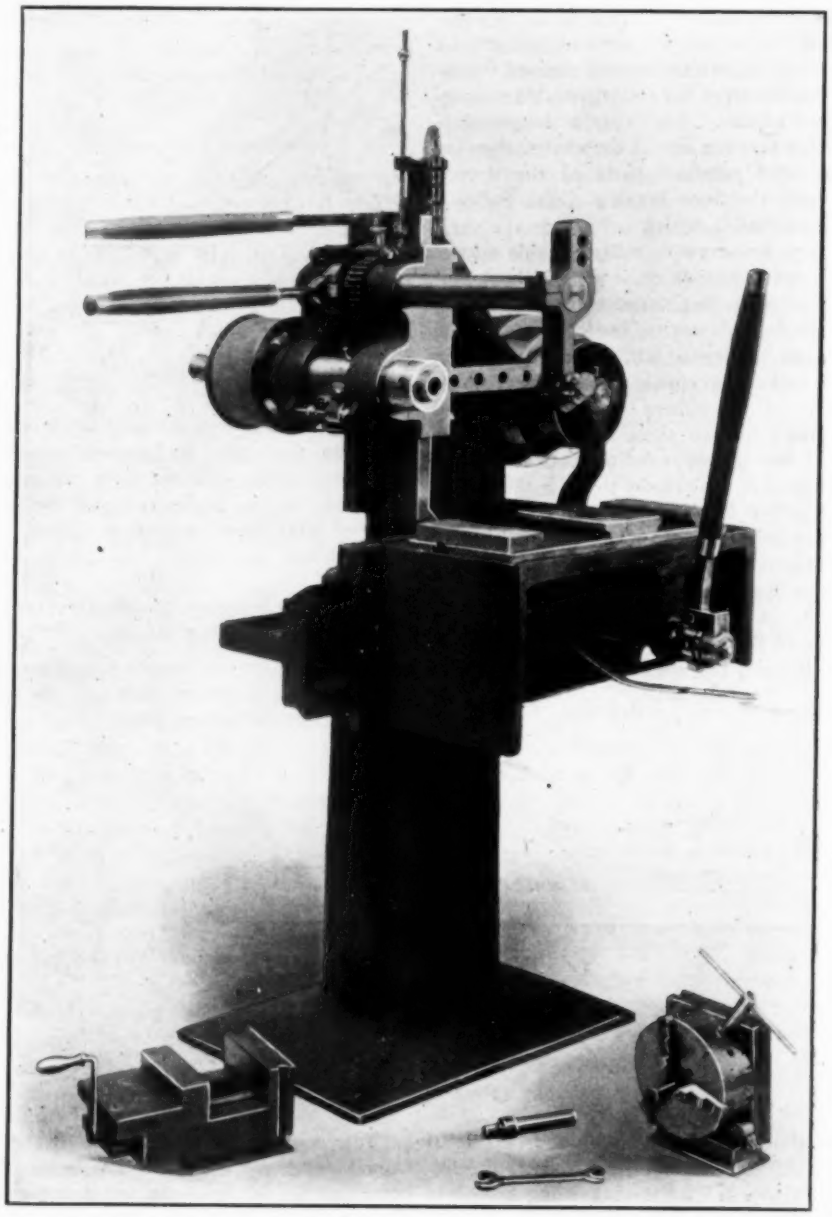


FIG. I. FARWELL QUICK-CHANGE MILLING MACHINE

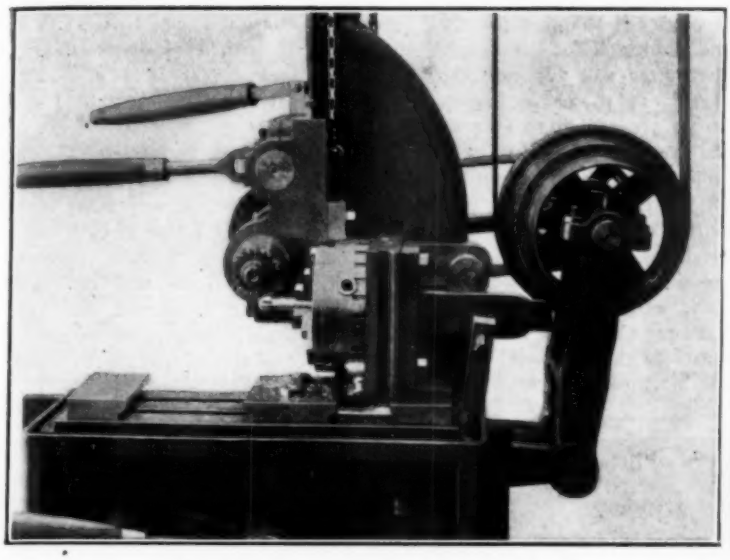


FIG. 2. MILLING A BALL MILL OR REAMER

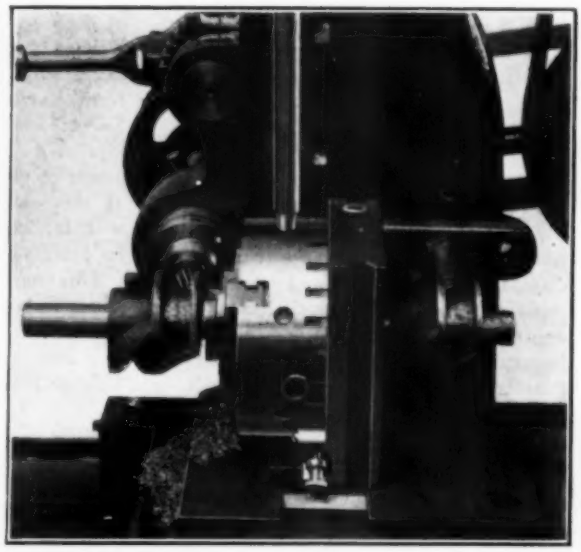


FIG. 3. CUTTING A CAM

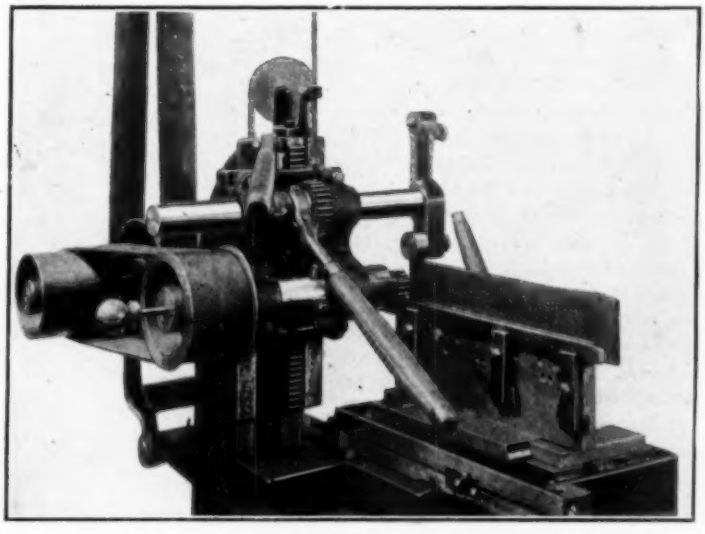
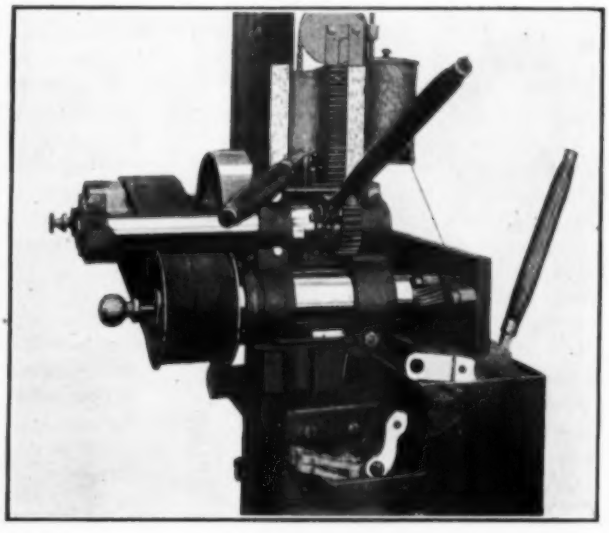


FIG. 4



PROFILING WITH A FORMER

FIG. 5

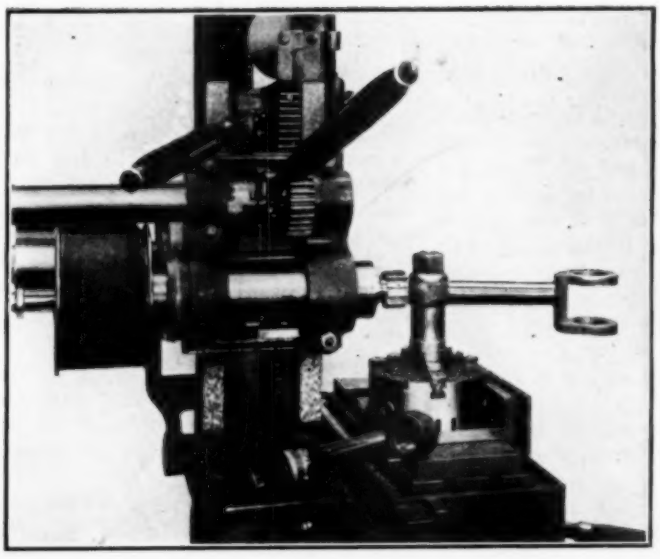


FIG. 6. MILLING THE ENDS OF CONNECTING RODS

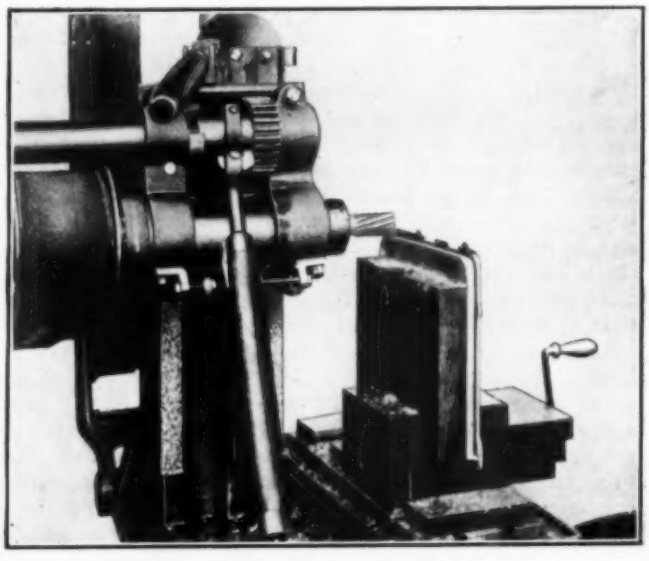


FIG. 7. PROFILING TOP AND SIDES OF A COVER

versing the sliding jaw the vise will hold work 6 inches wide. The vise is exceedingly heavy, and is provided with engaging flanges so it may be secured in the quick-change clamps in two vertical, as well as two horizontal positions.

The three-jawed chuck is 6 inches diameter, has two sets of jaws and will take 1-9/16 inches through the center. The chuck is mounted on a heavy angle plate which may be secured by the quick-change clamps in two vertical and in one horizontal position. This chuck has 24 stops or graduations which are very convenient in spacing cutters, laying out keyways on quarters or opposite sides of a shaft, or for squaring or milling hexagon heads. This chuck is also very convenient for circular milling.

The quick-change features, such as the positioning of the cutter in relation to the work, the quick locking or releasing of the various slides, the quick change of the position of the feed levers and the quick-change clamps for the vises, chucks and fixtures are peculiarities of this machine.

The feed levers not only move the table, spindle or head slides, but also lock these slides by a right-angle movement of the lever. This is of great convenience in profiling or when feeding in two directions. By this arrangement the table may be locked, the cutter fed into the work to proper depth, then locked, then the table released and the longitudinal feed begun, all without the use of wrenches or without the operator removing his hand from either of the levers.

The lever, when moved to the locking position, is disengaged from the pinion it controls, so the lever may be swung to a new position. The act of unlocking the slide re-engages the lever and the pinion in the new position.

In Fig. 1 all the feed levers are shown. In the position shown the levers engage the pinion, and the slides are free to be moved. Moving them down, the slides are locked, and the levers are disengaged from their pinions and may be instantly swung to a new position. A movement of the lever at right angles to the direction that moves the slide locks the slide and disengages the lever from the pinion so the lever may be swung to a new position.

In addition to the 5/8-inch T slot, the table is provided with two clamps operated by levers underneath the table. The chuck and vise furnished with the machine and special fixtures are designed to slide in these clamps and are secured in any position by a single motion of the lever.

The spindle head is provided with an arm extending back and in line with the spindle in which a guide pin may be secured either 4, 6, 8 or 10 inches from the spindle center. A guide pin may also be secured in the overhanging arm pendant either 2½ inches or 3½ inches from spindle center.

A roller the size of the cutter on either of these guide pins will follow a pattern secured to the table, chuck or angle plate, while the cutter will duplicate the form on the work, as shown in Fig. 3. Several operations are shown to give an idea of its wide range of usefulness. The power of the spindle drive and the rigidity of this machine permit of heavier cuts with larger cutters than are usually used on profiling machines.

This machine occupies a floor space of 36x42 inches, and weighs 1090 pounds. It is made by the Adams Company, Dubuque, Ia., and known as the Farwell Quick Change Milling Machine.

Designing a Three-point Ball Bearing

By Mercury

Considering the extensive use to which ball bearings have been put during the last few years it is surprising to find how little information there is to be had on the subject, and what a large amount of guesswork is used by some firms in their usual practice. In the automobile industry especially it is amazing to find the absolute ignorance displayed by some makers in designing these important details, losing in some cases as much as 25 per cent. of the efficiency of the bearing.

I was fortunate enough to be asked to take part in some private tests of the various types of ball bearings in use, the object being to ascertain which type of bearing was best suited for some light high-speed work, for which the firm had a large order.

The Three Vital Points

The three main points by which we judged each type of bearing were, least frictional resistance when running at a high velocity with a very light load; when running at a lower speed with a heavy load; least tendency for the ball to wear elliptical.

In every case we found that the three-point bearing *when properly constructed* was by far the best, and this is the one that I always recommend for light to medium work. Whether it is also suitable for very heavy work I cannot say, never having had sufficient experience to enable me to give a decided opinion.

The way to design the bearing is as follows: Draw *A B*, Fig. 1, parallel to the center line of bearing and at a distance from it equal to half the diameter of the ball circle plus half the diameter of a single ball. Next draw *B C* at right angles to it, making *D* any suitable radius.

Next draw in the ball as shown and through the point of contact draw the line *E F* and produce it till it meets the center line of bearing at *G*. Now draw *G H* tangent to the ball and touching it at *J*. Draw *J K* at right angles to *G H* to cut the ball at *K*; with *K* as center, and *K J* as radius, draw the arc *L J M* and the construction is complete.

Why This Is Superior

The reason that this ball race is superior (in my opinion) to any other is due to this fact, that the action of each ball in revolving is that of a cone revolving round its apex at *G*, as will be readily seen by drawing a second line (not shown) through *G*, tangent to the ball.

One effect of this is that the ball wears

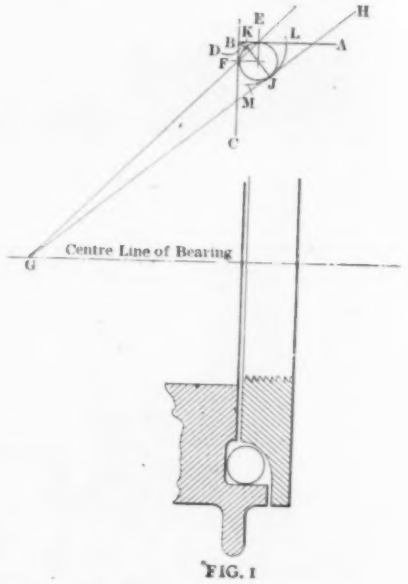


FIG. 1

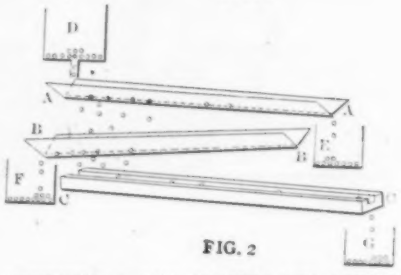


FIG. 2

DESIGNING A BALL BEARING AND TESTING THE BALLS

evenly all over and has no tendency to become oval in use. We proved this by using very soft balls, and we found that in every other case the balls lost their true shape; but with this three-point bearing, the balls, although diminished in size, still retained their spherical form.

This bearing is used, I believe, on all Rudge-Whitworth cycles, and the firm finds it a great success.

How Makers Test Balls

It may interest some of your readers to know how these balls are tested for accuracy by the manufacturers, before being sold.

One form of gage for ascertaining whether the balls are to size or not is shown diagrammatically at Fig. 2, where *A A* and *B B* are four steel strips, each

ground to a knife edge, and each pair being set so that the space between them is adjustable; the strips *A A* are set to the maximum limit and *B B* to the minimum. The balls are heaped into the receptacle *D*, whence they automatically fall one after another on to *A A;* those that are too large run into box *E* and are taken back to be re-ground; the others fall through on to *B B*, where the correct ones roll into box *F*, and those under size fall through on to the wooden trough *C C*, and thence into box *G*, and are "scrapped."

The method of testing the balls for a true spherical form is of a still more simple nature; the balls are poured on to a "chute" some six inches wide and inclined at a slight angle. The balls are allowed to roll down this and along the level, advantage being taken of the fact that a true spherical ball will not only roll in a straight line, but will also roll a longer distance than one out of truth.

Certain machinery, hardware and tools of American make are so firmly established on the markets of Queensland that it evidently only requires that their standard be maintained to prevent competing lines from obtaining a satisfactory foothold.

Turning a 12-inch Gun Roller Path

By Gompei Kuwada*

Kawasaki Dockyard Company was recently awarded a contract to furnish the Government with some sets of roller paths for 12-inch guns. These roller paths were each about 27 feet in diameter and consisted of ten sections of fan-shaped forgings.

As the contract was to furnish them entirely finished, they were at once presented with the problem of how to turn them, for the largest turning machine in the shop was a 13-foot boring and turning mill. This tool, with housings backed away, could turn only 20 feet in diameter. It lacked 7 feet and, besides, if the housings were backed away, the bevel face for the taper rollers could not be turned.

There was not sufficient time to build a special machine for the purpose, nor was the expense for such a tool to be entertained.

The method adopted was after the plan of large turning mills for generator frames. In the first place, the housings and the cross rail of the 13-foot boring mill were removed, leaving only the bed plate and the rotary table with its turning gear. Around this table there was built a brick-work ring. Upon this a cast-iron ring in sections was bolted down. On the face of this the work to be turned was to be fixed. Inside of this ring, and concentric to it, was bolted down another ring, also in sections, the top of which was to be used as a rail to steady the arms carrying the turning slides.

Upon the rotary table of the boring mill two arms were attached, the ends of which were faced and grooved to receive the tool slides. These tool slides were made so as to swivel, adjustable to the bevel faces of the work. On the under side of these arms, white metal shoes were placed to slide over the before mentioned rail ring. In addition there were fixed to them claws to catch under the projecting lip of the rail ring, serving also to steady the turning arms.

When all these parts were in their places the arms were rotated free of these supports, the white-metal shoes and the claws; and first, with a turning tool on the tool post, the under slide of the projecting lip of the rail was faced true; next, having

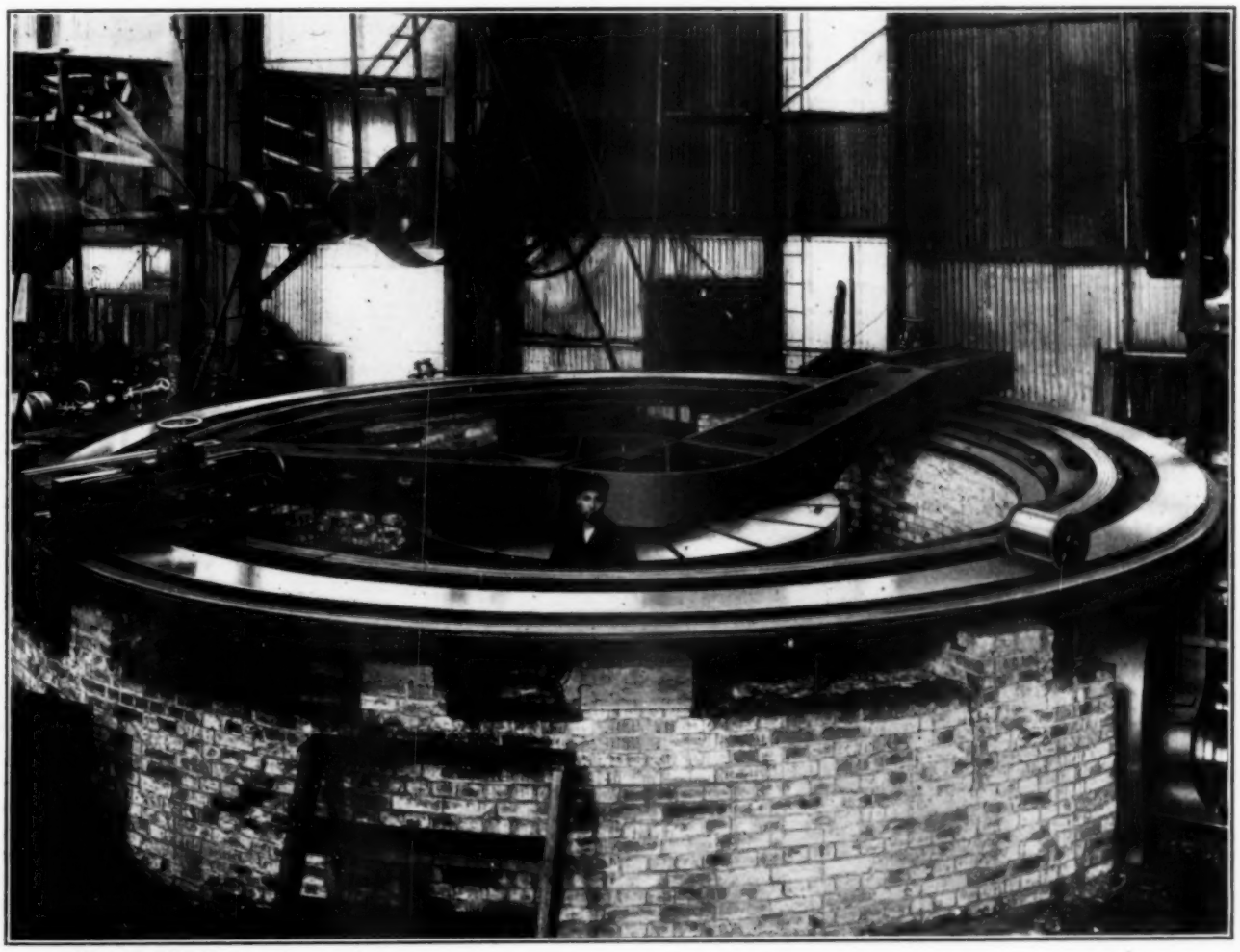


FIG. I. THE IMPROVISED MILL WITH A FINISHED ROLLER TRACK

*Engineer, Kawasaki Dockyard Co., Ltd., Kobe, Japan.

attached the claws to steady the arms against upward thrust of the tool, the top of the rail was faced. Now the white-metal shoes were inserted to bear on this rail face, and the turning arms were made perfectly steady for heavier cut and higher speed. Finally the face of the work-table ring was turned true, and the machine was ready to receive the work.

Fig. 1 shows the boring mill as altered with one of these roller paths finished.

As the forgings of the circular sections had in the rough state from one-half to one inch material to be taken off, and as they were liable to buckle out of line after the extra metal was taken off them, it was not practicable to operate on them from the start on the turning mill. It was necessary to rough them down by other means while the boring mill was being altered. To do so planers and milling machines were used. Usually to plane out an arc an attachment consisting of a compound sliding table and a radial bar is used, but this method could not be employed in this case, as the planers were set up close side by side and did not allow space to admit radial bars 12 feet in length.

To overcome this difficulty the following method was employed and with success. Each section of the roller path was an arc of 36 degrees, and 20 inches wide. As seen in Fig. 2 a guide bar of sufficient length was planed straight, then bent and clamped down on a rigid plate in an arc concentric to and of radius exactly 24 inches shorter than that of the center line of the work.

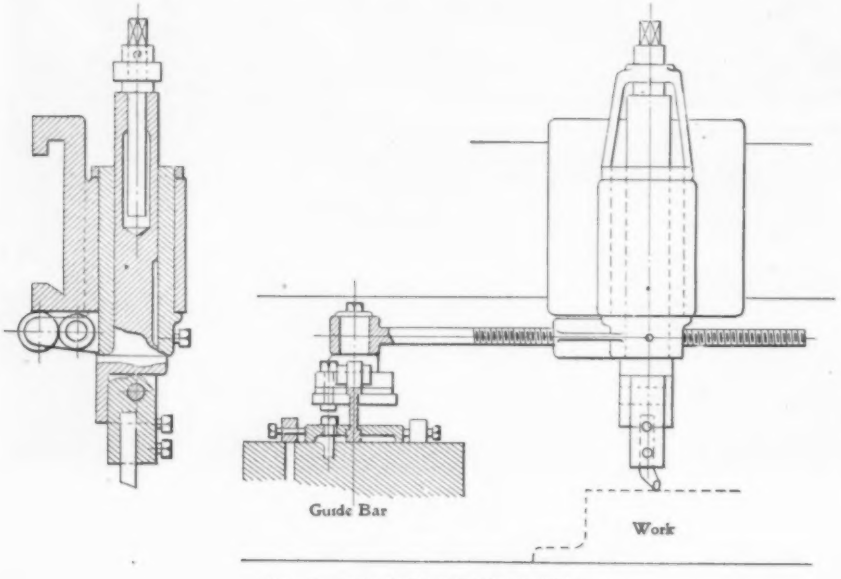


FIG. 2. THE ARC-PLANING DEVICE

This guide bar and the work were placed on the planer table exactly 24 inches apart at centers. Upon this guide bar was straddled a block bearing two pairs of rollers. Through this block there was inserted a screw that connected the tool post to this guide bar. On the cross rail of the planer there was mounted a special saddle carrying a tool post.

This saddle was bored out to receive a cylinder, at the back of which there project two lugs to receive this connecting rod.

Between these lugs there was placed a nut screwed into the square thread cut on the connecting rod. By turning this nut the distance between the guide bar and the tool could be varied, enabling the tool to be traversed over the width of the work.

The cylinder was bored to receive the tool post which could be raised or lowered by means of a hand wheel and an adjusting screw.

The end of the tool had a clapper box so that the tool would swing outward on the return stroke of the planer.

To turn the nut that gives the traversing motion, there was arranged at the rear a set of gears and a ratchet handle.

As seen in Fig. 3 the angle *A*, a line through the center of the four rollers and the connecting rod being fixed, and the cylindrical tool post left free to revolve in its saddle, the imaginary line *a b* (between the center of the four rollers and the tool) always keeps in the position of a line radial to the arc of the guide bar. As the tool is traversed to or from the guide bar, the tool point advances ahead of or recedes away from this radial line. To offset the error arising from this cause, two roller blocks were provided setting the connecting rod at angles *A* and *B* respectively correct for the two vertical sides of the work to be planed. It is easily seen that for flat faces, either of the two blocks could be used without causing any error.

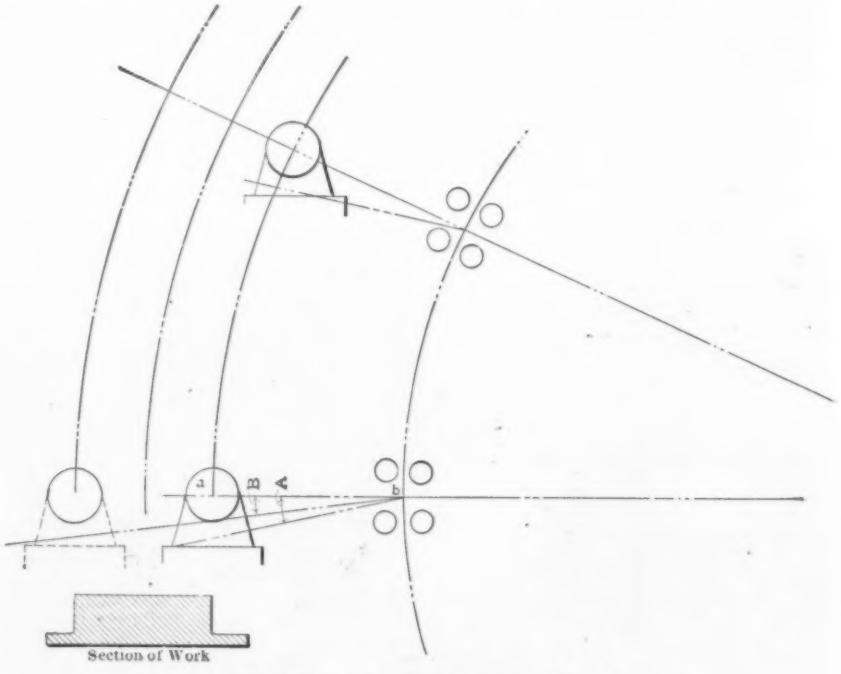


FIG. 3. THE WORK AND ARRANGEMENT OF THE ROLLERS

When this arrangement was used on the slab-milling machines, the connecting rod was reversed and one end collared and slipped over the vertical milling spindle and the screwed end inserted through the roller block. In this case only one roller block was provided as it is evident that the centers of the milling spindle and the roller block coincide with the line of the connecting rod.

By this method it was made possible to contain the whole mechanism between the housings of a planer, enabling them to employ it on any planer in their shop.

Thus all the forgings were roughed down to within one eighth of an inch of the true size, then they were scribed and after the ends of each section were fitted to assemble in a circle, they were taken over to the boring mill.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Core Box and Cores for Casting Screw Threads

The accompanying illustrations show the core and core box used for casting a screw thread on the outlet connection on the flushing tank, represented in Fig. 10, page 240, Vol. 29, Part 2, in the article on the Bonvillain rotative molding machine, upon which the mold is made; it is also shown in Fig. 5, page 49, and Fig. 7, page 50, Vol. 30, Part 2.*

The threaded connection in question may be seen on the tank which is upside down in the middle of the first figure referred to; on top of the cope pattern on the left is what is called a plug, serving as a core print for the core which is resting against the pattern in front; alongside of it to the left is the box in which it was made, better shown, with its central threaded pin in place, in Fig. 1 herewith. The core box is of white metal, and the central pin of mild steel. This core box was made entirely in the foundry, with the exception of the central pin. In Fig. 2 a box is shown with the pin taken out, and in Fig. 3 are shown two cores. On one side of the core box may be seen a groove which makes a corresponding projection on the core, so that not only this groove is made by casting, without a fin, but in addition the thread starts always at the same point on the circumference, which is a great convenience to the person who puts them in position. The casting is used as it comes from the foundry, with positively no machine work; when it was made by hand a cheek was required, but with the machine molding the cheek has been done away with, so as to avoid a fin at the joint.

E. RONCERAY.

FIG. 1. CORE-BOX WITH PIN IN PLACE

FIG. 2. CORE-BOX WITH PIN REMOVED

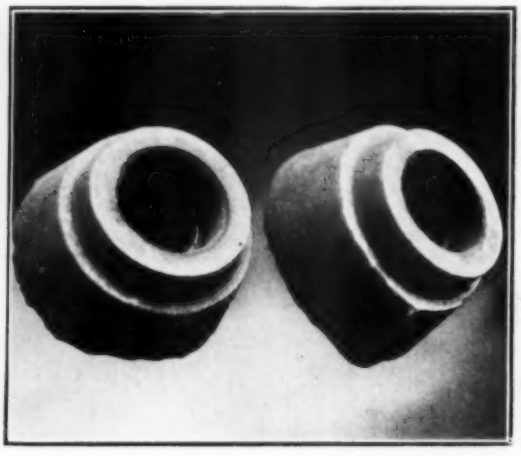


FIG. 3. CORES FOR CASTING SCREW-THREADS

*The Fig. 3 referred to in the caption of the last named cut is a mistake for Fig. 5.

Distortion of Steel in Hardening

On page 859, Volume 30, Part 1, J. H. Madigan criticizes my article on fitting a hardened plug and quotes me as saying that I allowed three ten-thousandths (0.0003) of an inch for swelling in a two and one-half inch plug. My article reads three thousandths (0.003) of an inch. He then suggests that I should have stated the brand of steel. This fact is not material as there are numerous brands that will act in this manner. However, the plug in question was made of Jessop's cast steel.

As his experience with carbon steels has evidently been limited, I would like to have him take a piece of Jessop's cast steel one half inch in diameter and about three inches long, center it and take a cut in the lathe deep enough to get under the outside scale. Care should be used to get a nice smooth finishing cut. Then carefully caliper with a micrometer.

Next heat this piece to a cherry red and plunge it in water. After cooling, caliper it again with the micrometer and if he never knew that steel would swell in hardening, the result will astonish him. He will not be able to lay it to any "distortion of threads" either. I am perfectly willing to admit that there was distortion of the thread in the plug I made; but I know too that it swelled. I also admit that a chaser could have been made of iron or soft steel, but brass allows the emery to bed itself nicely and so is preferable.

Referring to Alloy's article on the same page I should judge that the piece of steel that he heated the hottest and left in the forge must have had some air flowing past it, or was so placed that air could get to it, as coal or coke would hardly be air tight after the fire died out. The second piece surely could have been no softer than at first. Most of my experience on high-speed steel has been with "Novo" and "Burgess' No. 5 Special." The only satisfactory means that I have found of annealing is as I stated before: "Heat to a good white heat (not burning) and let cool slowly without coming in contact with air." If anyone knows of a better or simpler way than by packing in lime or mica, inclosed in a cylinder, I should be glad to hear of it. I don't claim that this is the only way but it is a method that has invariably given me satisfactory results.

ETHAN VIALL.

Automatic Coin-weighing

The automatic coin-weighing machine, shown at page 18, interested me, but I could not understand why all the coins should be weighed twice. It seems to me the desired result could be accomplished if they were all first weighed in one machine having a maximum weight in the pan, and then those that were of less than the maximum weight again weighed in another machine having a minimum weight in the pan. This would just as effectually sift out those coins-

above and below the legal limits of weight, and slightly cut down the time required to do the weighing. Besides, the "good heavy" and "good light" coins would be mixed automatically and as thoroughly as they could be by human agency. If experience demonstrated that the condemned "light" coins were greater in number than the condemned "heavy" coins, it would be an advantage to do the first weighing with the minimum weight in the pan.

There may be some point in the method in use that I have failed to grasp, and if so I should like to be enlightened.

WALTER GRIBBEN.

Mistakes Due to the Abbreviated Drawings of Screw Threads

I cannot allow the article on "Mistakes Due to the Abbreviated Drawing of Screw Threads," page 495, Vol. 30, Part 1, pass without criticizing this "criticism" of the way screw threads are shown and should be shown on drawings. I will venture to say that the method shown by Fig. 1 of that article is the most common form used on modern drawings. The only necessary additions to make it foolproof are to show the screwed portion carried nearer to the head, and to state the form of thread; the latter point, however, is unnecessary in many shops.

I cannot imagine a man making the screw as shown by Fig. 2, page 495, when

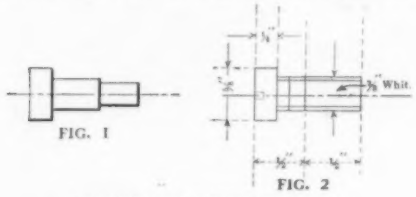


FIG. 1 FIG. 2

ABBREVIATED SCREW THREADS

working to the Fig. 1 drawing. For instance, how does he account for the outer dotted lines extending through the tapped plate? He must entirely ignore these lines in making the screw, and it is only reasonable to assume that as he failed to connect the outer lines with the screw at all he would be justified in making a plain pin like the accompanying Fig. 1. This is, of course, absurd; but no more so than the mistake supposed to have been made. Then again, the dimension 7/16 inch must be from his own imagination. He surely could not have been a mechanic to attempt to make the screw fit as the sketch would suggest, both on a shoulder and head.

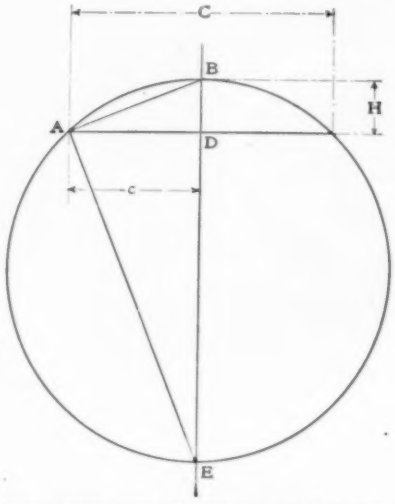
Referring to Fig. 3, page 495, did anyone ever hear of ordinary hexagon-headed screws or bolts with square threads? Certainly the method of showing the thread is bad and scarcely ever used, but even so, I fail to see how any but the merest novice would make the mistake. In ninety-nine cases out of a hundred a glance at the drawing would tell a man whether square or angular threads were required. Failing in this, he would naturally inquire, in case definite particulars were not given.

Fig. 4, on page 495, is out of all reason. While probably suitable for patent office drawings and such like, it would take up altogether too much time, both of draftsman and tracer, to ever become standard; especially as it is so obviously unnecessary. In fact, I think the article is really getting at a fault which exists only in someone's imagination.

Given a sketch as shown in the accompanying Fig. 2, what more can anyone want? G. H. S.

Another Method of Calculating the Radius of an Arc for a Given Span and Rise

At page 636, Vol. 30, Part 1, F. L. S. describes a method for finding the radius of any arc, given the chord and the versed sine of half the arc, or, in other words, the "rise." There's a method that I have been using for some time past which I



CALCULATING THE RADIUS OF AN ARC FOR A GIVEN SPAN AND RISE

thought would interest some of your readers. Having a considerable quantity of work of this description to do some three years ago, I was looking over some old data and struck upon the following formula, but in a different form.

Let C be the given chord and H the given rise. As is well known, if any two straight lines be drawn from the extremities of the diameter of a circle and meet in any point in the circumference, then is the angle contained by these two straight lines a right angle. $B\,A\,E$ is a right angle. $\therefore$ Angle $B\,A\,D$ = angle $A\,E\,D$. Let $c = \frac{C}{2}$. Then, as the lengths c and H are known, we know $\frac{c}{H}$, which is cotangent $B\,A\,D$. But cot. $B\,A\,D$ = cot. $A\,E\,D$. $\therefore$ *cot.* $B\,A\,D \times c$ = side $D\,E$; and $D\,E + H$ = diameter of circle, or radius $\times 2$. This may be written then as:

$$\text{Radius} = \frac{c \times \textit{cot.}\ B\,A\,D + H}{2}.$$

Example—Let the chord be 6 inches and the rise 1 inch.

$\frac{Chord}{2} = 3$ inches. $\therefore$ *cot.* $B\,A\,D = \frac{3}{1}$, which $= 3$.

$$\text{Radius} = \frac{(3 \times 3) + 1}{2} = 5 \text{ inches, which}$$

is the radius required.

London. T. O. OLMAKER.

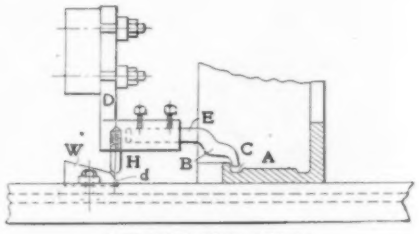
[The above solution is derived in a manner different from the one previously published, but it really amounts to the same thing. If we substitute in the formula the value of the cot. $B\,A\,D = \frac{c}{H}$, we have:

$$\text{Radius} = \frac{c \times \frac{c}{H} + H}{2} = \frac{\frac{c^2}{H} + H}{2},$$

which is the same as the formula of F. L. S.—ED.]

A Planer Tool Lifter

The accompanying cut shows one of the devices we have used for a number of years, and which never failed to do its duty.



A PLANER TOOL LIFTER

This planer tool lifter is used for planing lathe heads where the binder spot is below the box seat.

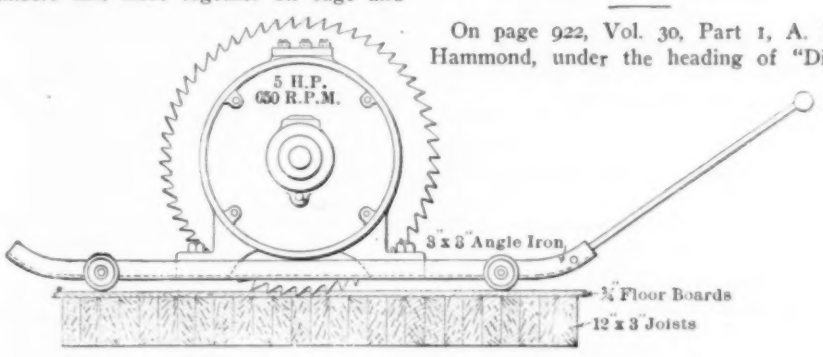
The cut shows the surface A to be planed ½ inch below the surface B, the recess C cannot be made long enough to allow a planer tool to get a start.

The device is of simple construction as will be seen. D is made of cast iron, the upper part is made the size of steel generally used for planer tools, the lower part has a hole in it to receive the cutting tool E, which is held by two screws. I is a steel pin rounded at the lower end, and is fastened in the casting D. W is a casting with two inclined planes bolted on the planer table. The cut shows the casting receding from the tool E. The pin H is about to rise on the incline W, which will raise the tool E, so that it will not strike the surface B. While the casting is traveling toward the cutting tool, H will go down gradually, but just as the tool is within ¼ inch of beginning to cut the pin I will drop down the steep incline L, and

bring the tool in position for the next cut. This operation of course takes no longer than it would under ordinary circumstances. JOHN WHEATON.

Cutting Up Flooring for Removal

In the machine shop of a large electrical company the floors of the three upper galleries were constructed of 12x3-inch timbers laid close together on edge and supported by I-beams. On top of these timbers was nailed the flooring, consisting of 5x¾-inch tongued and grooved boards. Each gallery was 900 feet long by 60 feet wide. The machinery was arranged down each side of the galleries, leaving a passage or gangway 8 feet wide down the center. There was a considerable amount of heavy trucking down these gangways, which cut up the flooring so rapidly that it was considered advisable to adopt some other method of flooring.



PORTABLE MOTOR-DRIVEN SAW FOR CUTTING FLOOR BOARDS

It was decided to cut up the old flooring boards, to the width of the gangway, and lay asphalt on top of the 12x3-inch timbers.

The problem then presented itself of how to cut up the old boards quickly enough to keep pace with the asphalters, and without interfering with the routine work of the shop. At first a gang of carpenters was employed to chop off the boards with chisels, but this was found to be too slow and laborious.

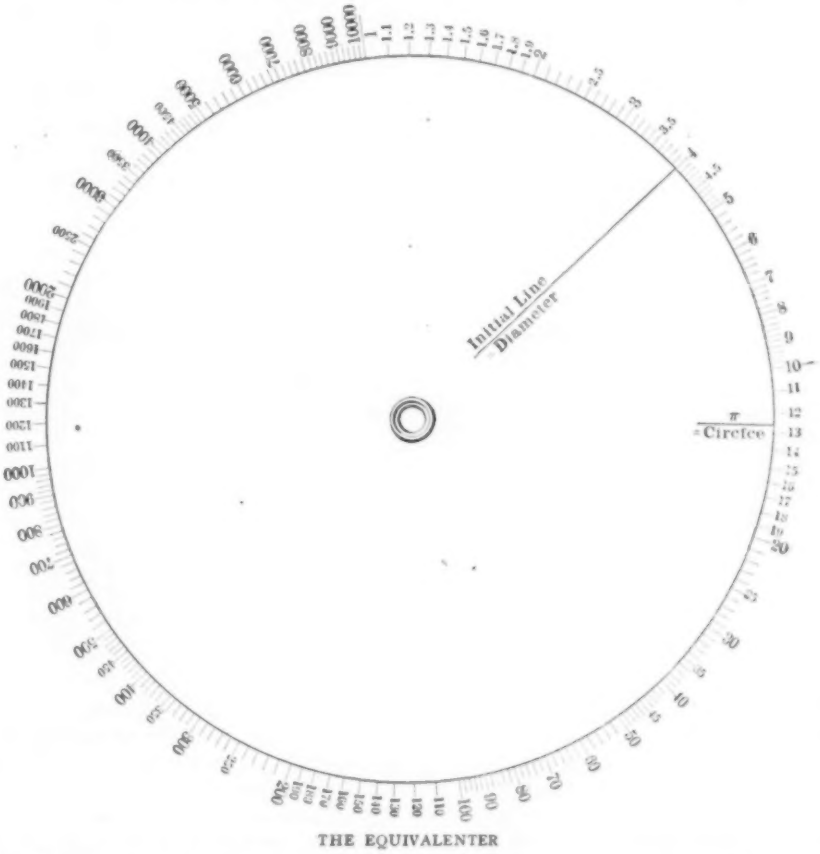
A circular saw was rigged up on the spindle of a 5-horse-power motor, as shown in the sketch, and the motor was mounted on four wheels. The hight of the motor was so arranged as to allow the saw to project ¾-inch below the bottom of the wheels. A handle at the front to pull, and a length of flexible cable to connect to the power circuit, completed the equipment.

The method of using this portable saw was to block up the front end of the motor until the saw cleared the floor, start the motor, then withdraw the blocks, and gradually lower the saw until the rig rested on the wheels. The saw was then drawn along, cutting through the boards in a straight line. As is obvious, this was a great saving over the first method of cutting up the boards. The saw was run down each side of the gangway, and the boards were lifted by the asphalters as required. No serious difficulty was experienced due to meeting an occasional nail, as the saw required sharpening only once in cutting up 5000 feet of flooring. The motor ran at 650 revolutions per minute. The only labor required for sawing was one man and a boy.

FRANK SANFORD.

The Equivalenter

On page 922, Vol. 30, Part 1, A. N. Hammond, under the heading of "Diagrams Versus Formulas," asks "What diagram would you use to illustrate $\pi = 3.1415926$?" Of course, it would be very easy to make such a diagram, but I herewith illustrate a sample of what I should use, namely, my "Equivalenter," which may also be used for many other ratios.



THE EQUIVALENTER

This computer consists of a circular logarithmic scale numbered from 1 to 10,000, with, in some cases, a blank revolving disk upon which ratios or equivalents can be set off as desired. In other cases a graduated revolving disk is provided, the graduations being the same as those of the outer scale. In this latter case the ratios are taken on the revolving graduated disk, while in the former case they are marked on the blank disk as required, with pencil or pen and ink.

To use the equivalenter, proceed as follows: Suppose the ratio of 3 to 7 is given, from which to find any other equivalent ratio.

1. When the revolving disk is graduated. Turn the revolving disk around until 3 is opposite the first term of the equivalent ratio, say 6, when opposite 7 will be found the second term, namely 14.

2. When the revolving disk is not graduated. Turn the disk around until the long initial line coincides with 3, then with pen or pencil draw a short line to coincide with 7. If the disk is now turned round, so that the long radial line is opposite 6, it will be seen that the short line is opposite 14.

The equivalenter may be used for a variety of calculations, such as diameters and circumferences of circles, steam-engine constants, pumping-engine deliveries, metric calculations, reduction of cubic feet to gallons, etc. For desk use and more accurate work, the large size 12x12 inches, is recommended instead of the smaller size, 6½x6½ inches. It seems to me that by this method formulas are much more easily and readably solved than by diagrams. WM. COX.

Oil Baths for Quenching High-speed Steel Tools

After using the oil tank described by O. M. Becker at page 413 of the AMERICAN MACHINIST of March 22, for a period of about a year, I would make a criticism for the benefit of any of your readers who may contemplate putting in similar tanks.

In the tank, a section of which is shown in Fig. 1, the oil is kept cool by the water jacket around and the water column in the middle of the tank. It is also cooled by the air which is forced through the oil under pressure from the blower. Air was first used in this way to keep the oil stirred up, but after careful usage we find that in addition to keeping the oil agitated it keeps it cold. The air does more to keep down the temperature of the oil than the water in the water jacket does. We are accordingly installing a tank like that shown in Fig. 2, which has several advantages over Fig. 1, because:

There is no center column, which makes it possible to dip the largest kind of tools without danger of bumping the edges, which is serious when the tools are white hot.

By using slightly larger air pipes and supplying a little more air than in the first case, the temperature of the oil will stay below 150 degrees Fahrenheit. We often allow it to rise to this temperature when dipping large milling cutters and dies.

The new tank, while taking the same floor space, holds a larger volume of oil, which is a distinct advantage.

There is no occasion to have water near the tank. This prevents accidental mixtures which will sometimes occur in the tanks first named through the carelessness of someone letting the water splash over the narrow partition between the oil and water.

The second type of tank is much cheaper than the former. The air pipes can be put into any sufficently large and fireproof tank. The arrangement of these is shown in Fig. 3.

M. DOGECLA.

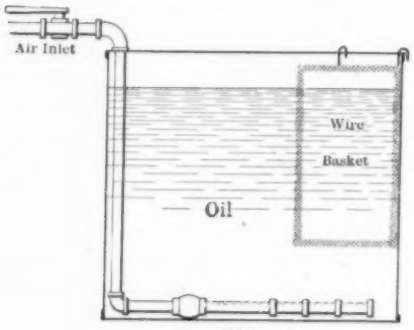


FIG. 2

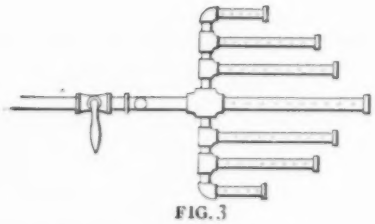


FIG. 3

AIR COOLED TANKS AND AIR PIPES

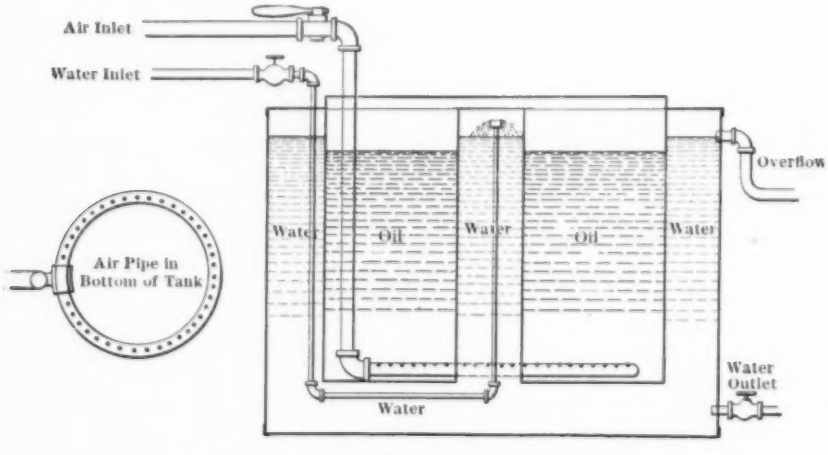


FIG. 1. OIL BATH FOR COOLING HIGH-SPEED STEEL

Drill Jig for Knuckle Joints

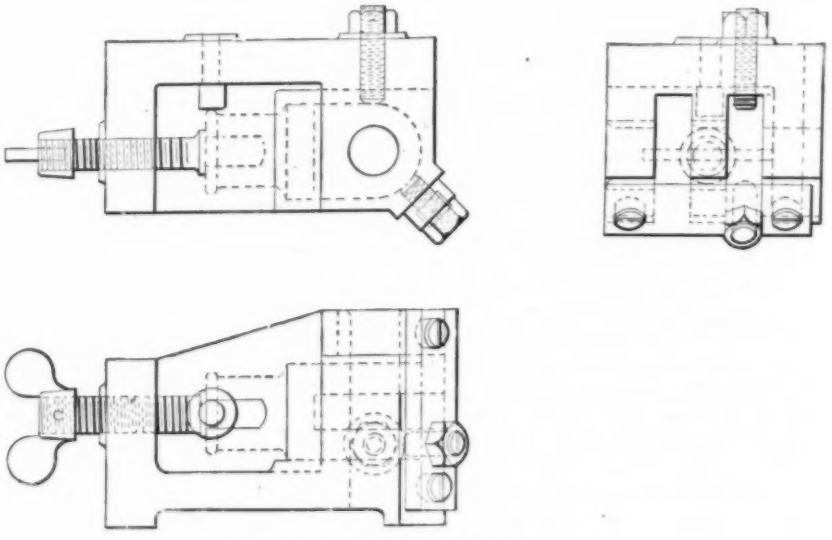
That Gutta Gitta jig, on page 497, for knuckle joints seems to me a poor proposition for practical use. It looks very good on paper, also as if it would work; but the locating qualities are not good.

The illustration shows a jig which I think will answer the purpose in every way. I have considered economy in making the pattern, casting, finishing, convenience in placing or taking out work, and correct location.

The reason why I have no clamp on the outside is that the rotation of the drill will keep the job against the pin stop.

If clamping projections are thought to be necessary, they can easily be added.

R. M. H.



DRILL JIG FOR KNUCKLE JOINTS

Uses of Powdered Oilstone

The advantages of this substance are so little appreciated by mechanics generally that I believe the following should be of considerable value. The powder is the refuse from the cutting of stones to the desired forms and is to be obtained from the supply houses at 10 cents a pound for the American make, and 20 cents a pound for the French. For economical reasons and in view of the satisfactory results obtained, I should recommend a trial, particularly where close work is the general practice.

Let us say we have a circular former cutter which through hardening or other causes gave an incorrect size on the finished product. This is very apt to occur when the cutter is fed to cut on the side, necessitating the cutter being set on an angle; part of the cutter, if it be a broad one, will be considerably below center, sufficiently so to produce a wrong diameter. This can best be corrected by the use of oilstone powder and a cast-iron

lap, particularly where sharp corners are desired, whereas otherwise it would most likely necessitate a new former. With the most suitable emery wheel you cannot approach the sharp corners and smooth surface obtained by oil.

Use of Oilstone on a Cast-iron Lap

The method employed is the same as one would use in emery-wheel grinding, in place of the emery wheel a cast-iron lap about two inches in diameter being used, running at a speed of about 600 revolutions per minute or a surface travel of 314 feet per minute. The surface travel of the cutter should be approximately the same, just slow enough to prevent the oil-

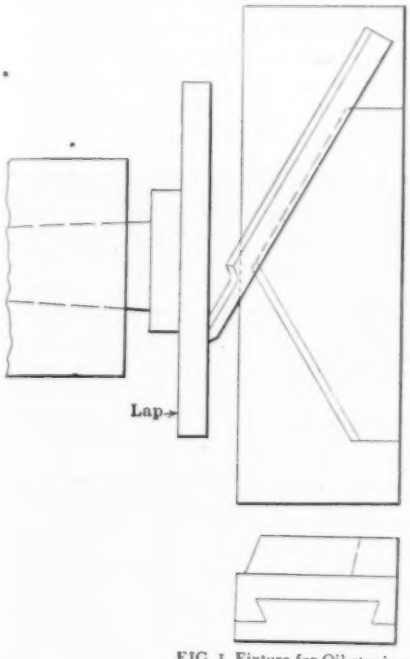


FIG. 1 Fixture for Oil-stoning Threading Tools.

FIG. 2 Circular Brush

USES OF POWDERED OILSTONE

stone from flying off the lap. The oilstone is mixed with oil for convenience of applying, besides adhering to the lap better when wet. It is applied to the lap with a small brush, and but a small quantity at a time is required to perform its work. Care must be taken to avoid crowding the lap, otherwise you lose the sharp corner so much desired. An ear trumpet, as is commonly used in light boring, is a great advantage.

Fine Finish on Cutters

Let us say we have a master former cutter, which we wish to reproduce with accuracy. It is in such cases as this that the great advantage of oilstone comes in; its use leaves on the cutters absolutely no burs, which have been the source of much annoyance to good mechanics and others. You have brought the cutter you are making down to form, and desire to take a finish cut leaving a sharp and true form. Take your cutter, place it on a table rest and sharpen it with oilstone; it gives you a perfectly flat and smooth top absolutely free from the slightest bur. A better condition could not be desired. The lap in this instance should be from four to six inches in diameter.

A Fixture for Oilstoning Threading Tools

Many shops do not have the patented threading tool, and those that do supply them frequently find the old-style tool in use. In this connection oilstoning with a fixture, as shown in Fig. 1, should be adopted as a matter of economy. The excellent condition in which the oilstone leaves the tool dispenses with the necessity for the man standing at the grindstone calling his reserve genius into play trying to exclude light from between the gage and the tool.

The tool is placed on the fixture, oilstone applied to the cast-iron lap—which should have been roughed with a coarse file, the lines running radially to permit lodgment of the oilstone—and with a gentle pressure of the tool against the lap the slide should be moved back and forth. The result is just what you are after.

Use of Oilstone on Brushes

A circular bristle brush, Fig. 2, mounted on the lathe, with the use of oilstone will clean hardened work of fire stain and remove small burs from work while soft, without damage, if a very small quantity is used. It is particularly useful on small ratchet teeth and pinions and work of that nature.

To remove burs on hardened work, a wire brush like Fig. 2 is more satisfactory. For the convenient handling of oilstone on brushes and felt laps, when used for the purpose of smoothing a rounded surface before polishing with powdered lime, melt a small quantity of paraffin wax, add oilstone powder and stir until it thickens somewhat, keeping it warm meanwhile. Then set it away and allow it to cool. Oilstone in this form will stick to the brushes and felt better than with oil.

FRANK METZLER.

A Simple Drill Chuck

There have been several drill chucks sprung on the market lately, constructed so that the drill can be taken out and a new one put in its place, without stopping the machine.

Most of these are expensive, but the one shown on the enclosed drawing does not have this objection. In fact it would be rather difficult to design one simpler and cheaper, in which the machine had to be stopped to take out the drill. There is very little expense over the ordinary taper sleeve. It consists of four parts, one of which is an ordinary ball as used in ball bearings, and this is the thing that does the trick.

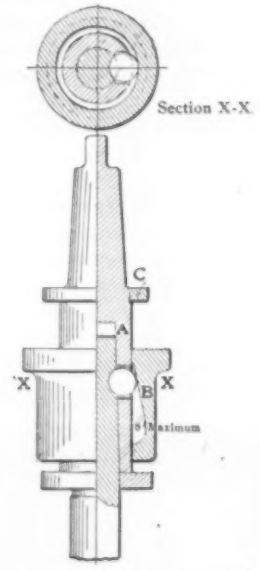


FIG. 1. A SIMPLE DRILL CHUCK

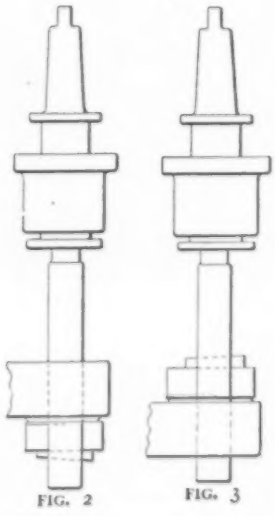


FIG. 2 FIG. 3

THE CHUCK USED FOR FACING

The hole drilled in *A* does not go right through, but as is shown in the end view, thus preventing the ball from dropping out when the drill is removed.

B is a collar turned on the inside as shown. It will be seen that if the collar is lifted the ball will fall into the deepest part of the recess, allowing the drill to be withdrawn, and a new one put in its place. The collar is then allowed to fall, and the taper part of the recess forces the ball into the groove milled in the shank of the drill.

If the chuck is being used vertically, as in a drilling machine, gravity will be enough to keep the sleeve *B* down, and the drill tight, but if it is used horizontally, as in a lathe, then a light spring

between washer *C* and sleeve *B* will be necessary.

It can be seen that the sleeve *B* may be lifted while the chuck is running and the drill removed, the sleeve *B* remaining stationary in the hand, while the shank *A* revolves.

It can be used for facing as shown in Figs. 2 and 3, and works perfectly well.

I have had several of these made for the shop, and they are working admirably, the time saved in removing drills on repetition work being enormous.

The taper of the recess in *B* should not be more than 8 degrees, and it is advisable to keep it less, otherwise the ball is liable to push the sleeve up; it should also be noticed that the deep end of the recess in *B* should allow the ball to enter enough to be quite clear of the inside of *A* where the drill fits, otherwise the drill cannot be pushed up past the ball; also the ball must drop far enough into the hole to allow the sleeve *B* to pass over it at the points it fits on *A*.

I have shown the shank of the drills taper, because I have used it mostly on taper shank drills, but it works just as well with straight-shank drills.

Collar *C* is to prevent the sleeve *A* coming off when the chuck is out of the machine, and also for the spring when it is being used horizontally.

The sleeve *B* will have to be hardened if it is to last any time. S. L. HARDY.

Turning a Large Spur Gear Without a Lathe

We had received an order to make three large spur-gear wheels and it was a question how to do the machining. The largest was 28 feet in pitch diameter, built up of ten segments. The arms were let into a boss 7 feet in diameter. The planing of the segments on the ends, the drilling for the bolts to bolt them together, and the turning of the ends of the arms at the boss were easy enough; but the meeting surfaces of arms and segments were circular and required a large lathe to turn them.

The largest lathe would take only 20 feet, with no possible way to make it more; so we were in difficulty, as we did not wish the work to go away from the shop. After various suggestions the machine-

FIG. 1

FIG. 2

PARTS USED IN MACHINING GEAR WHEEL

shop foreman decided to do the work on a planer. He had two wrought-iron bars (see Fig. 1) forged 7 inches wide, 2 inches thick and about 6 inches longer than the saddle piece on the segment that was to be turned. The slot was marked out accurately to the diameter of the bore and machined true. Then a bar was made, shown by Fig. 2, and the ends turned to take two blocks that were machined to fit the slots in the piece of Fig. 1.

The ring of segments having been bolted together and the radius of the bore marked out, we were ready to begin. Two of the segments were fixed on the planer table with one of the slide bars on each side. The piece of Fig. 2 was bolted under the tool box, from which the screw had been removed, so that it could slide up and down, and the machine was started. Great care was taken to plane to the lines so that all of the segments should be the same thickness. A tool bar with two tools was used to save time, as the segments had strips about 2½ inches wide at each side to be machined. The half-tone Fig. 3 shows the process.

After all the segments had been machined they were again bolted together to form a ring, and when gaged were found to be perfectly round. In fact, it would be impossible to tell that they had not been turned in a lathe.

Now the arms had to be dealt with. After fitting them into the boss a center piece was turned to fit the boss. This was bolted down on a table and the boss dropped on to it. The end of the arm was fastened to the ram of a large shaper.

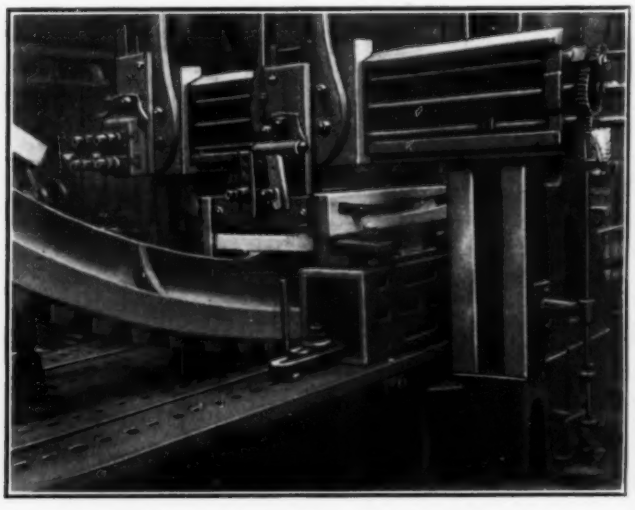


FIG. 3. MACHINING A SEGMENT

FIG. 4. MACHINING AN ARM

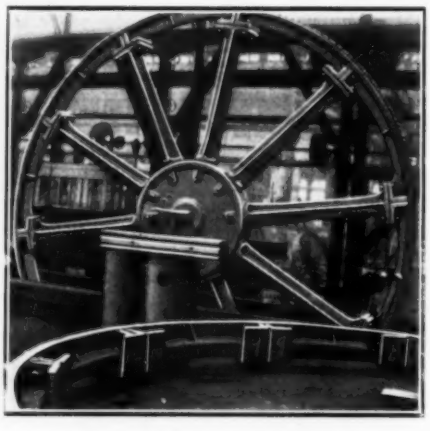


FIG. 5. ASSEMBLED WHEEL

A tool rest was bolted down to the table of the shaper and all was ready for cutting. As the center was fixed, the boss and arm moved around as the shaper worked, thus making the correct radius, as shown in the half-tone Fig. 4. The arms were turned to a gage for length, and when dropped into the ring of segments fitted nicely. Upon the wheels being erected and barred round, they were found to be true at the pitch line and not more than ⅛ inch out of truth sideways. Fig. 5 shows an assembled wheel.

INSPECTOR.

Hydrofluoric acid as a cleaning agent for castings has been in use but a short time, says the *Scientific American*, being treated a few years ago as a secret process. Formulas for the acid containing superfluous and innocuous ingredients to mystify the purchaser have been sold for considerable sums. Anything used in connection with this pickle aside from the hydrofluoric acid and water is wholly unnecessary.

A New Cold Metal Saw—The Lea-Simplex

Cold metal saws are almost as commonly known today as their prototype the circular saws, yet the limits of design are by no means reached. Within the last 80 days a new design called the Lea-Simplex, has been developed by the Lea Equipment Company, of 136 Liberty street, New York City. This is shown in the three half-tones and the line engraving, which accompany this descriptive article.

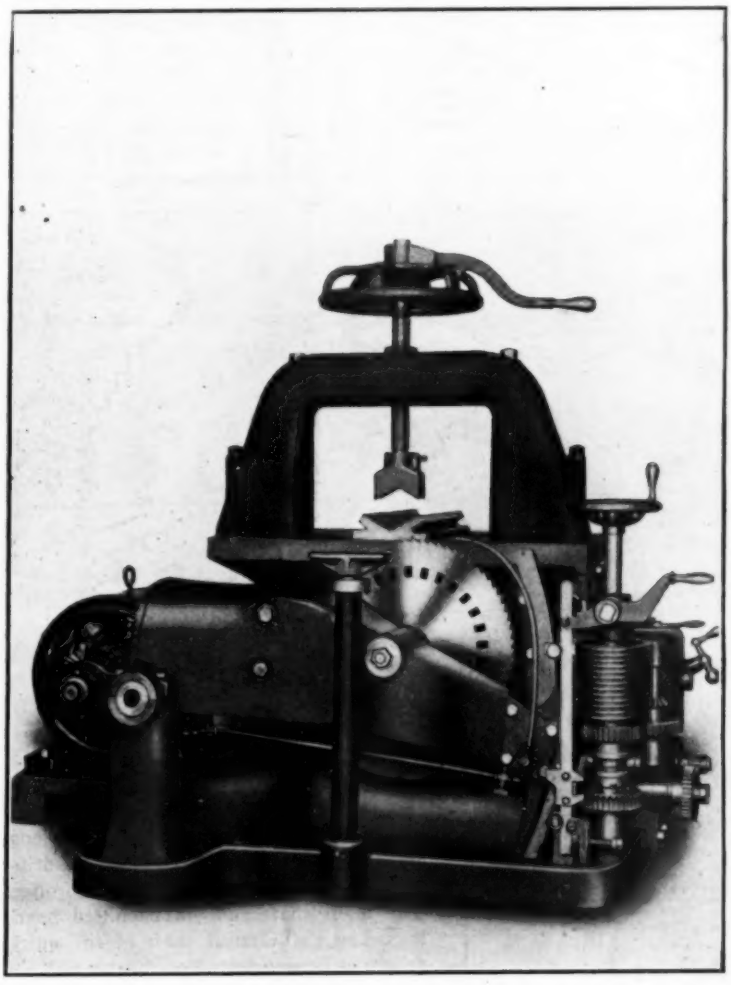


FIG. 1. FRONT VIEW

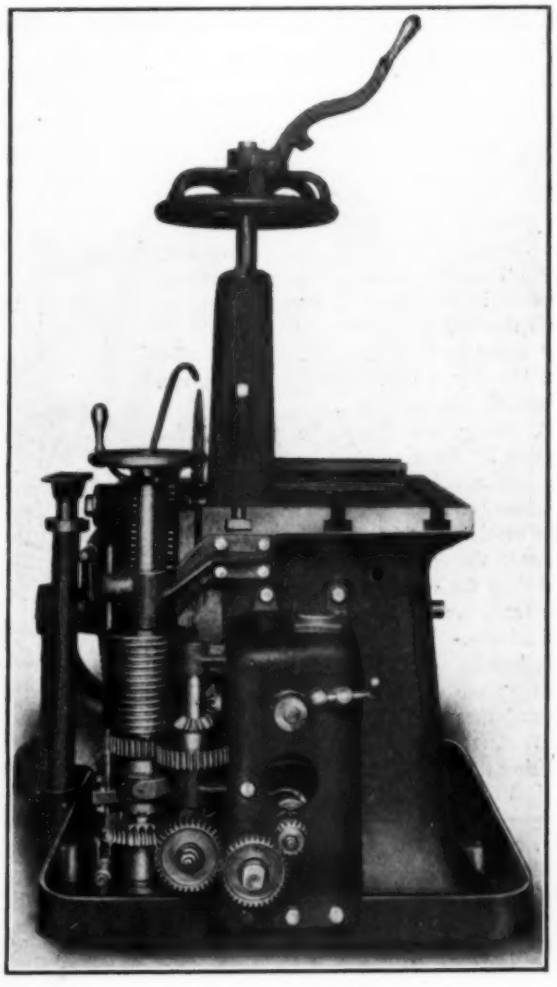


FIG. 2. END VIEW

LEA-SIMPLEX COLD METAL SAW

The Frame

The frame or base is of a box construction, with the work-clamping arch as a separate piece. All of the mechanism, except one shaft, is external to the frame, to facilitate inspection and repairs. The platen is provided with three T-slots to permit of strapping down work of irregular shape. Into its rear edge is set a tool-steel strip to prevent wear. This strip is shown in Fig. 3. Ordinary shaped stock is clamped in the usual manner between V-blocks, one on the platen, the other on a screw carried by the arch. Irregular shaped stock can be clamped direct to the platen, as indicated. The lower V-block is solid for its entire length, and is made of cast iron. The upper V-block is of steel, and has two crotches at right angles with each other. One is planed to 120 degrees, the other to 90 degrees, thus adapting it for a wide range from very small to large pieces.

The arch is of a closed box section arranged to clamp to the T-slots of the platen, and is located by dowel pins. The lever shown above the hand wheel does away with the piece of bar stock or pipe so frequently used, to increase the leverage. This lever is detachable. It is centered on the end of the screw above the wheel, and has a lug to engage with the spokes.

The Machine Drive

The illustration, Fig. 1, shows a motor as a source of power, although the saw, as assembled in what is called a standard machine, is provided with tight and loose pulleys, or a friction clutch for a belt drive. However, each frame has locating spots surfaced, drilled and tapped to attach a motor-bed plate if a motor drive is desired. A motor with a 33⅓ per cent. speed variation is recommended. The transmission from the motor to the machine may be by gearing or a silent chain.

The Blade Drive

The saw is driven by a chrome nickel steel pinion or sprocket, engaging with radial slots in the blade. Thus it has the advantage of pulling the saw through the work by means of the slots, which are near the periphery of the saw.

The part of the blade in contact with the driving sprocket is protected from side thrust by four tool-steel guides. These guides are ground to fit and have a temper just soft enough to avoid any injury to the blade. They are adjustable for wear by means of tapering steel shoes.

The bore of the sprocket is a tapered hole to fit a conical nose on the spindle. Both hole and nose are ground to a fit, and the sprocket is keyed in place and clamped with a nut and washer. This construction allows of easy removal of the sprocket if occasion demands.

By this method of driving back lash is eliminated, and the blade arbor merely centers it without the necessity of an arbor large enough to drive. The line engraving, Fig. 4, shows this drive.

The Sprocket

The driving sprocket is made of special, Krupp, chrome nickel steel of a tensile strength of about 250,000 pounds per

square inch, and an elastic limit of about 225,000 pounds per square inch. It has planed teeth. It is hardened and tempered and should possess great endurance.

The Blade Arm

The blade arm is shown in position in Fig. 1, and partly disassembled in Fig. 3. Its construction can be readily seen. The raising and lowering of this arm is accomplished by the large Hindley worm, shown at the right in Fig. 1. This worm engages with the sector cut on the end of the arm. The motion of this arm, and thus the feed of the saw is uniform for any given setting.

The Blade-feeding Mechanism

The variable feeding mechanism consists of two cast-iron cones, having between them a wide leather friction wheel. The friction wheel is mounted on wooden oilless bearings, thus doing away with the necessity for oiling, and so changing the character of the friction surfaces by any oil which might drop upon them. Motion is transmitted from the driver cone through a reducing or back gear to the worm and worm gear, shown under the Hindley worm. This mechanism can be plainly seen in Fig. 2.

A spring, which can be adjusted for tension by the graduated hand-wheel near the bottom of the feed box, provides the necessary tension on the friction wheel. The motion of this wheel back and forth between the cones changes the speed ratio and thus the rate of saw feed. The limits are from 3/16 inch per minute to 1 inch per minute.

A handle and graduated dial will be seen on top of the feed box, and a little toward the right. This indicates the rate of feed, and variations are produced by shifting the handle.

Control of the Blade

An important feature is the control of the saw. This is accomplished by the operating lever, seen above the Hindley worm. When this lever is in its neutral position—where it is held by a spring—the saw arm can be quickly raised to the work by the hand wheel. An upward movement of the operating lever starts the feed by engaging a clutch with the vertical shaft carrying the Hindley worm. When the cut is finished an adjustable stop trips the reversing clutch, and the saw arm returns to its neutral position. The rate of return is 12 feet per minute.

Bearings and Lubrication

All of the worms and spiral gears run against roller or ball-thrust bearings. The bearings in the feed box are of hard bronze. The saw-arbor bearing is long and is made of hard brass, while its driving shaft bearings are of Tobin bronze. The main shaft runs in babbitted bearings, and the vertical shaft of the quick return is in wooden oilless bushings.

The question of lubrication for the blade is cared for by a pump taking its supply, through suitable strainers, from the large trough in the base. The discharge pipe is attached to the saw arm, moves with it, and so always delivers at the same point on the blade for all positions of the feed. There is storage capacity for a large amount of lubricant in each machine. For the size illustrated, No. 20, this capacity is 11 gallons.

To guard against accidental failures of this system the blade dips into a steel pan attached to the arm. This is always full of lubricant which the saw takes up as it revolves. The overflow from this pan goes into the trough around the base.

Stock Support

An adjustable stock support is made a

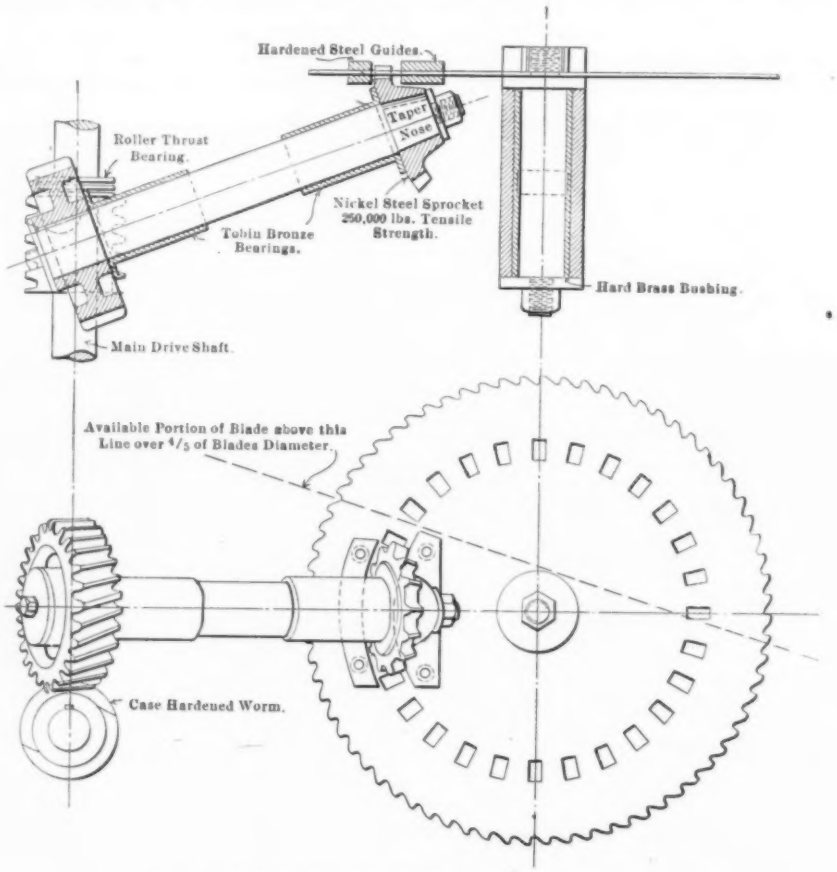


FIG. 4. BLADE DRIVE OF THE LEA-SIMPLEX COLD SAW

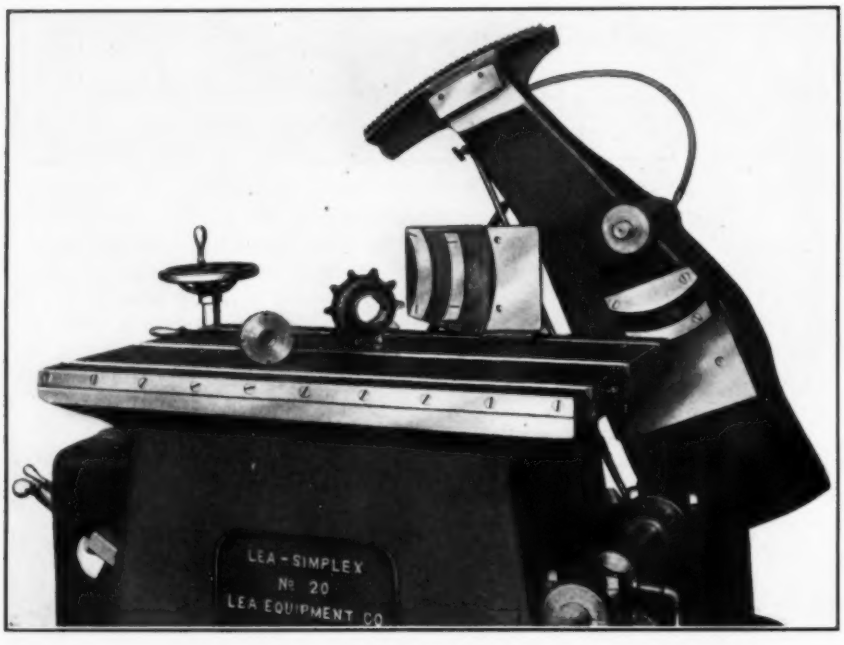


FIG. 3. DETAILS OF THE BLADE ARM

part of the machine, as shown in Fig. 1.

These machines are manufactured in four sizes, Nos. 13½, 15, 18 and 20. In each case the size number indicates the diameter of the new blade used.

New Offices and Factory of the Keuffel & Esser Company

The fortieth anniversary of the founding of the Keuffel & Esser Company, well known as dealers and manufacturers of drawing, surveying and mathematical instruments and supplies, was celebrated by the dedication of their new buildings at Third and Adams streets, Hoboken, N. J., on July 20. The general offices of the company are to be moved to the new five-story building, which affords much better facilities for office work and shipping than could be had in New York, but 127 Fulton street will still be used as the New York store.

The dedication exercises were attended by all the employees, who were given a holiday, by representatives of the press and a few others, and were very pleasing in spite of the cutting short of the interesting address of C. M. Bernegau, the treasurer, by a sudden downpour which had been threatening all the morning. The music opened with "My Country, 'Tis of Thee," and five large flags were run out during the singing of the "Star-Spangled Banner."

One of the interesting features was the presentation of a clock and a table for the directors' room to the firm by the employees as an evidence of their loyalty and good will.

After an inspection of the new plant a substantial lunch was served on the upper floor of the office building, at which both employees and guests were present, and the best of feeling was evidenced on every hand.

The "Tilted Turret" Lathe

The accompanying half-tone illustrates a turret lathe designed to carry the ordinary types of turret tools and short box tools and at the same time allow a very long piece of work to be machined with ease.

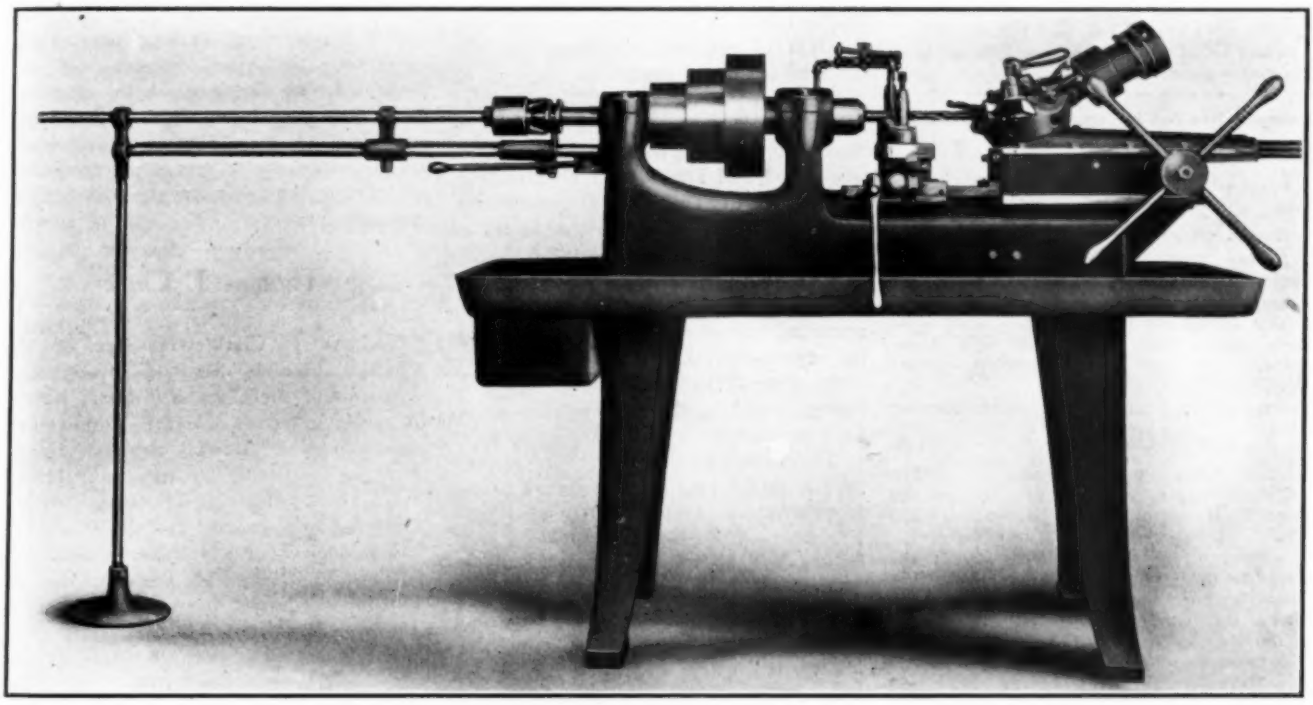
Its general features are clearly shown in the cut. It has a wire feed, self-oiling bearings for the spindle oiled from a chamber of ample size, a cross-slide for back and front tools and a large pan and circulating pump for the cutting lubricant.

The novel feature is the turret. This is hexagonal in shape and is mounted on its slide rest at an angle of 15 degrees with the horizontal. It is fitted with holes and binder bushings for round-shanked tools, and its faces are square with the spindle. To these faces box tools may be attached. By means of the turret angle, when a turret tool is swung over the slide it is at an angle of 30 degrees with the horizontal, thereby permitting the use of a larger tool as the clearance over the slide is increased.

Another point in the turret design is the row of holes below the tools. These are bored clear through and allow work to pass through the turret and back over the slide without interfering with the tools which might be in the back hole or fastened to the rear face.

Thus long stock and work may be handled without an undue overhang for the tools. Each hole of the turret has an independent stop fastened at the rear of the turret slide as shown.

The machine is manufactured by the Wood Turret Machine Company of Terre Haute, Indiana, and the size illustrated takes up to one-inch stock. Other sizes are under construction.



THE "TILTED TURRET" LATHE

Detailed studies have recently been made by the Massachusetts State Board of Health of various industries, and the characteristic and unhygienic conditions of each clearly outlined. Through all these reports runs the conclusive evidence that most of these conditions can be materially improved by the introduction of suitable ventilating apparatus. This is particularly true of those cases where dust or fumes are formed at local points in connection with machines, vats, furnaces, and the like.

Considerable progress is being made in Europe in turbine air compressors, Professor Rateau having constructed machines which compress air to six and even seven atmospheres, and fifteen compressors varying from 800 to 2000 horse-power are now on order. The efficiency of these machines is said to be of the same order as that of piston compressors, and, contrary to what might be expected, the machines possess great flexibility in output. The machines are compounded, compressors with a single wheel being only suitable for an outlet pressure of about one-half atmosphere.

AMERICAN MACHINIST

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Contents

	PAGE
Vertical Spindle Surface Grinder	145
Adjusting Gages by Peening	150
Heat Treatment of Alloyed Steels	152
The Lewis Formula Applied to Bevel Gears	155
Proportions of Machine Screw Heads	156
Simplifying a Difficult Cam Job	156
Fixing Premium Rates Discussed	157
A Device for Transmitting Power Between Two Inclined Shafts by Means of a Straight Belt	159
Permanence of Gages	159
A Handy Milling Machine	160
Designing a Three-point Ball Bearing	162
Turning a 12-inch Gun Roller Path	163
Practical Letters from Our Readers: Core Box and Cores for Casting Screw Threads....Distortion of Steel in Hardening....Automatic Coin-weighing....Mistakes Due to the Abbreviated Drawings of Screw Threads....Another Method of Calculating the Radius of an Arc for a Given Span and Rise....A Planer Tool Lifter....Cutting up Flooring for Removal....The Equivalenter ....Oil Baths for Quenching High-speed Steel Tools....Uses of Powdered Oilstone....A Simple Drill Chuck....Turning a Large Spur Gear Without a Lathe	165-170
A New Cold Metal Saw—The Lea Simplex	171
New Offices and Factory of the Keuffel & Esser & Company	173
The "Tilted Turret" Lathe	173
The Award of the Boyden Premium	174
Thomas J. Clark	174
New Tools and Machine Shop Appliances	175
Personals	177

The Award of the Boyden Premium

The *Journal* of the Franklin Institute for July contains an announcement of the award of the Boyden premium, which was originally offered in 1859, and which has been, we believe, advertised in the *Journal* continuously ever since. The offer as it has appeared in the advertising columns of the *Journal* for more years than most readers of the AMERICAN MACHINIST remember reads: "Uriah A. Boyden, Esq., of Boston, Mass., has deposited with the Franklin Institute the sum of $1000, to be awarded as a premium to any resident of North America who shall determine by experiment whether all rays of light and other physical rays are or are not transmitted with the same velocity." The offer was subsequently more specifically defined by the board of managers, limiting it to the rays of the spectrum, known at the time the offer was made.

The award is to Dr. Paul R. Heyl, of Philadelphia, the committee of judges consisting of Hugo Bilgram, Prof. A. W. Goodspeed and Dr. George F. Stradling. The nature of Dr. Heyl's experiments, the result of which led to the award of the premium, is indicated in the following extract from the report of the judges:

"The applicant, 'Algol,' for the Boyden premium, has succeeded in demonstrating, by experiment, that those of the ultra-violet rays of light for which glass is transparent, have the same velocity as the light rays proper.

"He reasons that if the velocity of these rays were different they would not arrive, from a distant source, at the same time. For his tests he selected 'Algol,' a well-known variable star in the constellation Perseus, as the source of light. By means of a diffraction grating he eliminated all but the ultra-violet rays of a known frequency, and by focusing them on a sensitive plate, obtained photographs of the star.

"For the purpose of identifying the rays so recorded with the visible rays, regarding the time of their emission, he selected, for the time of his tests, the time during which the light of this star shows the peculiar phenomenon of fading and recovering. The period of this variation is known to be about six hours. During this period he took a number of photographs, one-half hour apart, each exposure being twenty minutes, the remaining ten minutes being employed for making the necessary preparations for the next exposure. He thus obtained a number of exposures of the star on the same sensitive plate, but shifted in position. After developing the plate, the successive images plainly showed a fading and recovering, and although the exact location of the minimum brightness could not, in the nature of things, be absolutely determined, the approximate coincidence of the time of the minimum brightness of the visible and the photographed rays was obvious. These tests were repeated a number of times to eliminate the possibility of error and also to take in a certain range of the ultra-violet rays, and since favorable opportunity for making these tests is not frequent, the investigation extended over a period of two years.

"The applicant then reasoned as follows: Assuming that the photographic minimum did not exactly coincide with the observed visual minimum, their difference did certainly not exceed an hour, and since the distance of Algol is no less than forty light years, the difference of the velocities of the ultra-violet and the visual rays could not exceed one part in 250,000. This close approximation established equality to all intents and purposes."

It will be observed that the solution of the problem is not a complete one, as it relates to the ultra-violet rays only, and not to the infra-red or heat rays of the spectrum. In view, however, of the length of time during which the offer has been standing, the institute is no doubt well justified in making the award, while the determination is certainly a creditable addition to the achievements of American scientific men.

Thomas J. Clark

Thomas J. Clark, treasurer of the Chicago Flexible Shaft Company, and president of the Clark & Stewart Manufacturing Company, Chicago, Illinois, died at Bryan, Ohio, Monday evening July 15, from an accident, having been thrown from his touring car, Thursday July 11, he being a contestant for the trophy of the Glidden Tour. Mr. Clark's body was brought to Chicago on Tuesday, July 16, and he was buried from his residence on Diversey Boulevard, Thursday, July 18.

Mr. Clark was only 38 years of age and had been wonderfully successful in business, as the Chicago Flexible Shaft Company had established branches all over the world.

The firm of the Clark & Stewart Manufacturing Company was organized for the purpose of manufacturing speedometers. Mr. Clark's affability of manner won for him an unusually wide circle of business associates and friends, and his untimely death will be most universally regretted by all with whom he was associated. He is survived by his wife and one child, a boy 3 years of age.

In melting brass or similar metals, too strong a heat is detrimental. Portions of the metal exposed will be melted and oxidized before the remainder is melted. The best practice is to have the metal melt as uniformly as possible so that all portions become liquid at about the same time. This avoids overheating any portion of it —*The Brass World.*

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

A New Radial Drill

The main feature of this radial drill is the number of speed changes, and the way in which they are obtained. The spindle has 24 changes of speed, and for each of these there are eight changes of automatic feed provided. Any of these can be instantly changed while the driving belt is in motion, the change being positive and without noise or shock.

In front of the feed box at the base two long levers are shown, and these control four changes of speed. The small locking lever shown between the two longer levers prevents more than one change being made at one time. Each long lever operates a double-throw clutch, which brings the proper gears into play through an intermediate shaft in the gear box, as shown in Fig. 2, to produce the desired changes of speed.

In addition to these, the small lever on the right side of the feed box brings the gears *D*, *E* and *F*, which are shown in the sectional view, into mesh with the proper gears on the intermediate shaft; and the three changes obtained in this way multiplied by those of the first driving shaft give 12 changes of speed. These are again doubled by means of the back gears, so that the entire 24 changes are obtained in this way. The back gears are brought into play by the lever at the base of the column, and this lever also brings the gear on the center shaft into

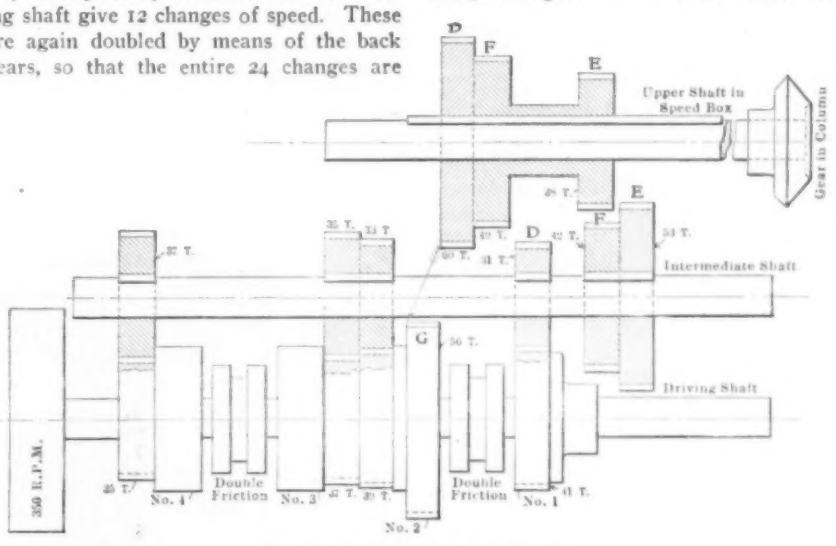


FIG. 2. SECTION OF SPEED BOX

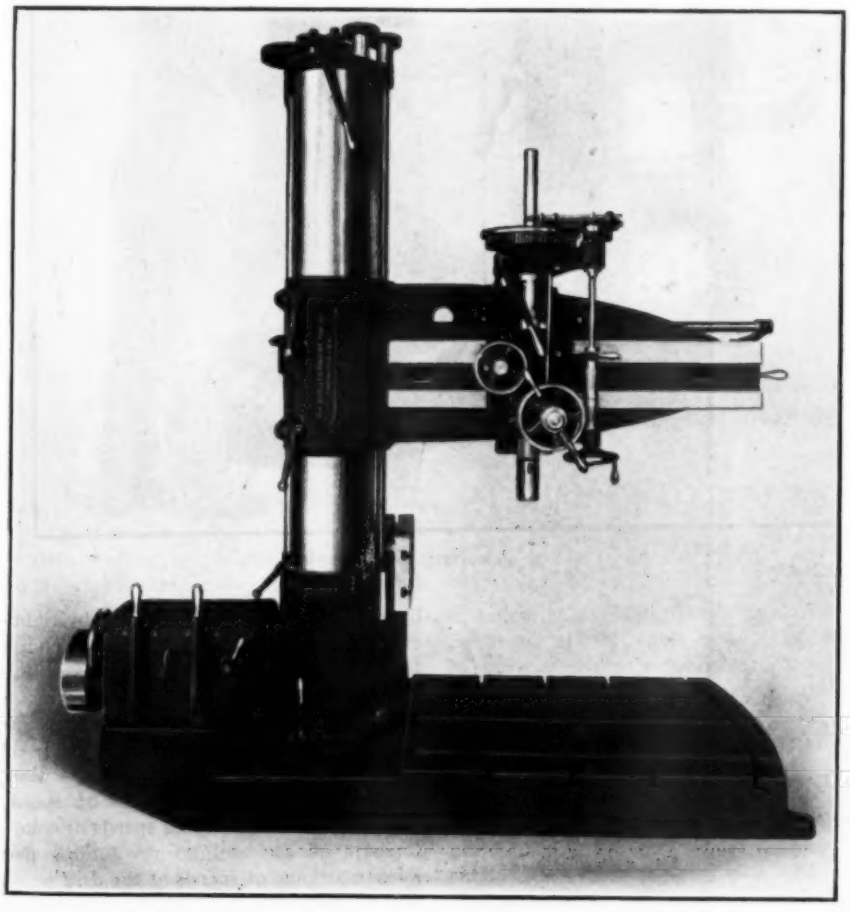


FIG. 1. A NEW RADIAL DRILL

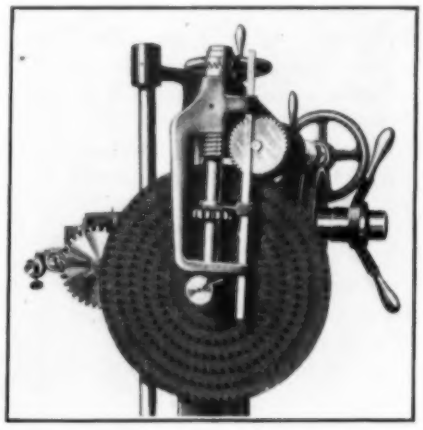


FIG. 3. TOP VIEW OF ARM, SHOWING FEEDING MECHANISM

mesh with the gear on the elevating screw when it is required to raise or lower the arm.

When the elevating screw is reversed while lowering the arm, the gears *D* and *G*, in Fig. 2, are in mesh in the feed box; this causes the upper shaft of the feed box to reverse without the aid of any intermediate gear. The column in this machine does not revolve, but is made in one piece and bolted fast to the base. Four webs inside, extending its entire length add to its strength and provide for resisting the strain of drilling, regardless of the hight of the arm.

The arm is hollow in section, with an upper brace as close as possible to the

head, and with the lower brace on the outer edge. This prevents twisting of the arm while resisting the upward pressure on the spindle due to drilling. The top cap rests on roller bearings, and supports the arm, both being capable of making a full circle about the column, if desired. They can both be instantly locked by the binding levers at any desired point. The arm is lowered at almost three times the elevating speed by a screw provided with ball truss bearings.

The spindle is of crucible steel, round and counterbalanced, and has a quick advance and return, with provision for taking up wear. It can be stopped, started and reversed for tapping by the long lever, shown in front of the head, which operates two self-adjusting noiseless friction clutches located behind it. When used for tapping it is impossible to engage either automatic or lever feed accidentally, and the breaking of taps is avoided in this way. There is also an adjustable gage nut which causes the spindle to slip when the tap reaches the bottom of a hole.

The automatic feed is positive for the drill spindle when high-speed drills and reamers are in use, and at the same time permits a feed being used where desirable, the operator easily changing from one to the other. This feed is shown in Fig. 3, where the round plate with its circles of steel pins is located above the spindle gear, these pins engaging with an involute steel pinion, as shown. This drives the horizontal worm shaft, the speed of this being varied by means of the knob below the lower hand wheel. This knob is fastened to a rod which extends through the center of the vertical feed shaft, and has teeth cut on the upper end; these engage with a sliding rack to hold the steel pinion at any desired point on the large plate, according to the speed wanted.

The upper worm wheel has a split half and by means of a ring nut can be locked to the vertical feed shaft for positive feed or slightly released if friction feed is required. There is an automatic trip with a safety strap to prevent the feeding of the spindle after it has reached the limit of its travel. There is also a graduated bar on the counterbalance weight which can be set to zero when the drill enters. This bar has several adjustable dogs to trip the feed as often as desired, and these do not interfere with the spindle travel. These can also be tripped by a lever on the vertical feed rod.

Letters and numbers are cast near the levers to show the operator how they should be moved for proper speeds, a list of these being given on the bronze plate fastened to the arm.

This machine is built by the Mueller Machine Tool Company, Cincinnati, Ohio.

Sensitive Radial Drill Press

This machine was designed to drive to advantage the sizes of drills that depend more on speed than on feed for their efficiency, viz., from ¼-inch to ¾-inch diameters. With this end in view the friction in the bearings has been reduced to a minimum by the use of balls, and the driving is done by a single belt, eliminating the use of gears. A patented idler device, best shown in Fig. 2, makes it possible to use a single belt in the drive, without interfering with the moving of the arm in an arc of 180 degrees, uniform tension being maintained on the belt, at the same time gears are not required.

A round table upon which the work is placed, revolving freely on balls, makes it easy, when used in connection with the swinging arm, for the operator to bring the drill to any position desired. This table is provided with a lock to make it stationary when desired. A square table is furnished with the machine, to be used in drilling small work, to bring it to the proper hight to be drilled easily by the operator.

The arm may be raised and lowered by a screw at the side of the column and may be held in the proper position by a screw at the side of the arm. The arm is also provided with a hole for receiving the guide bar of a tapping fixture, and the column which supports the arm may be locked in any position desired by tightening the screws in the bracket provided for the purpose.

The idler pulleys are arranged to move longitudinally upon ways provided for the purpose, so that the idlers may be used to tighten the belt within reasonable limits. There are eight changes of speed, and with the recommended speeds of countershaft of 400 and 90 revolutions per minute a range of speeds at the drill point will be obtained which will be found right for both drilling and tapping, these being

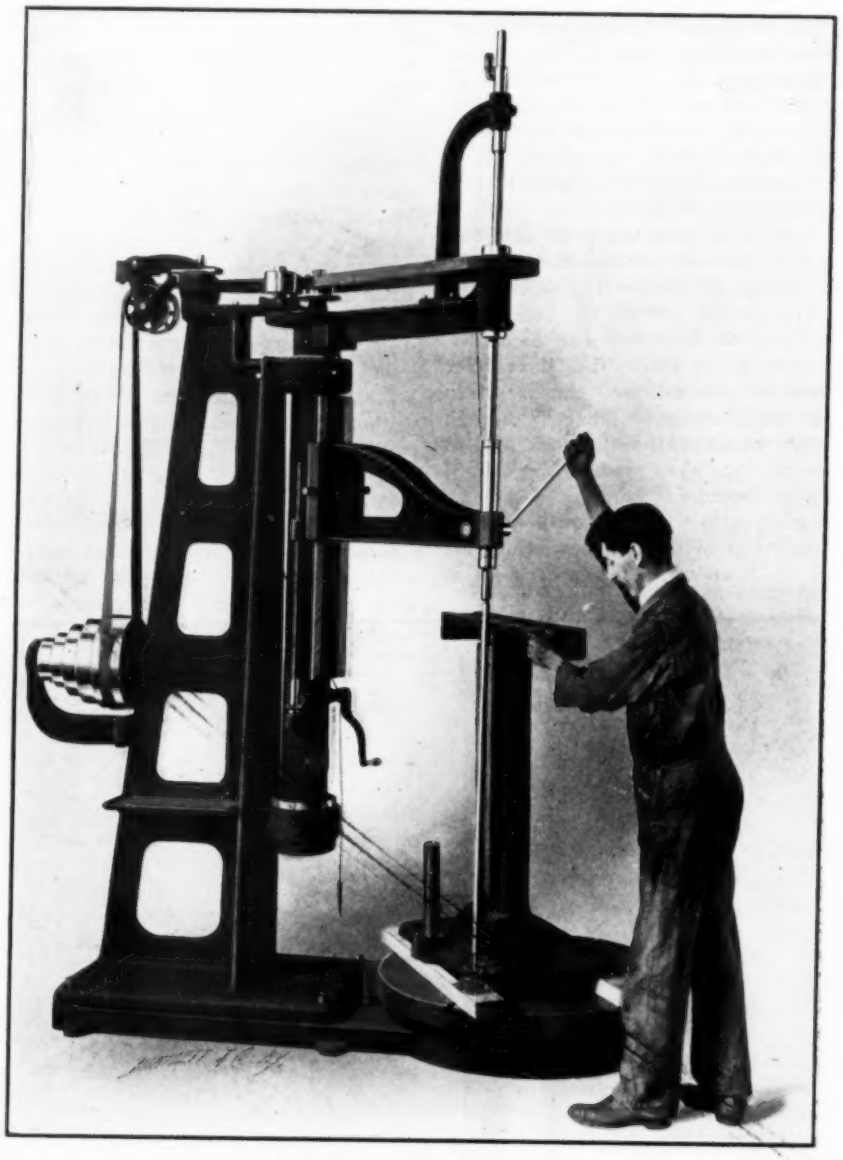


FIG. 1. SENSITIVE RADIAL DRILLER

as follows: 60, 90, 135, 205, 290, 435, 650 and 975. Although this machine is designed as a radial drill, it may be operated as a stationary drill, by locking the revolving table, the arm and the column; and the sub-table may be strapped to the revolving table, through the key slots provided for the purpose. It is made by the Henry & Wright Manufacturing Company, Hartford, Conn., and in it are incorporated many of the features of their sensitive drill, such as the balanced spindle drive, friction pinion, etc.

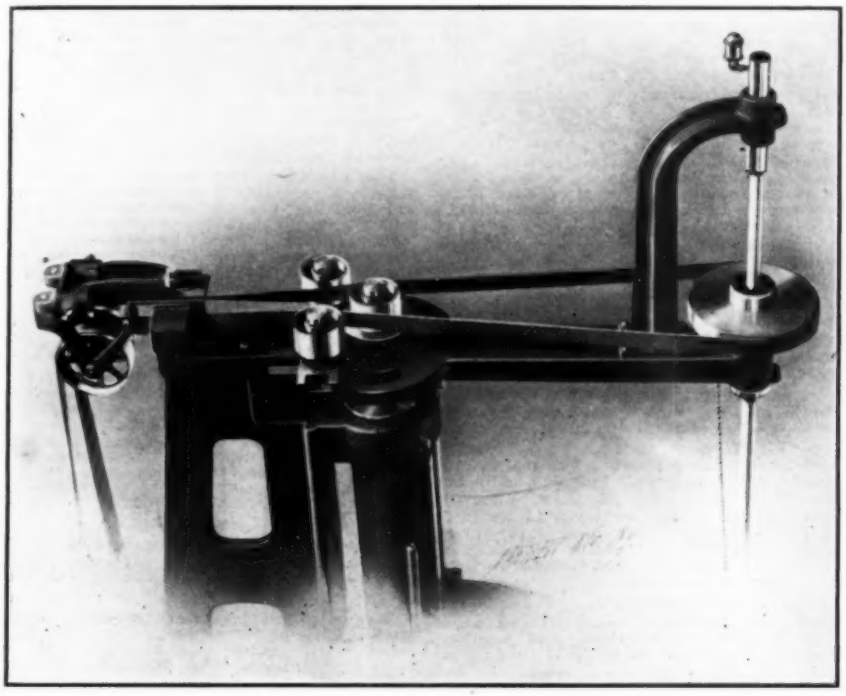
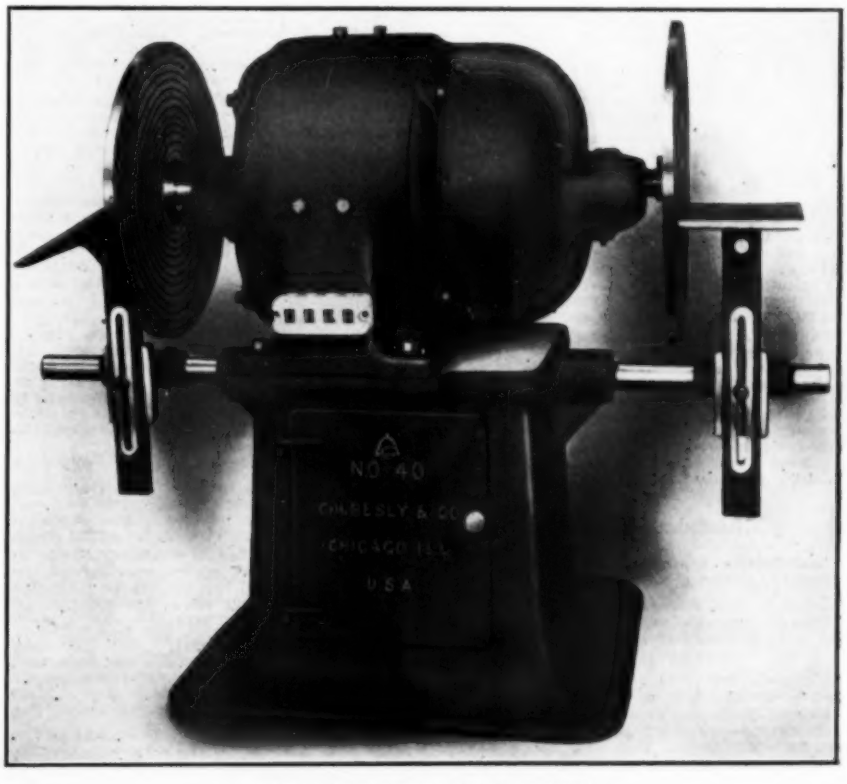


FIG. 2. ARRANGEMENT OF IDLERS ON THE RADIAL DRILLER

A Large Motor-driven Disk Grinder

The illustration shows what is probably the largest disk grinder ever built as it is driven by a 20 horse-power direct-current motor, which weighs a ton of itself. The controller and starting box are in the base of the machine, and the fuse blocks on the front as shown.

The machine is equipped with 26-inch steel disks, with the patented spiral grooves of the makers, C. H. Besly & Co., Chicago, Ill., and also has their adjustable tilting table, as shown. The size of the machine and its driving power show that the disk grinder has made a field for itself, and that its usefulness is not confined to small work.



LARGE MOTOR-DRIVEN DISK GRINDER

Personal

J. D. Bird, Superintendent Gas Engine Department, Fairbanks, Morse & Co., Beloit, Wis., has resigned his position to accept the post of assistant manager of the International Pump Company, Harrison, N. J. A pleasing termination of his connection with Fairbanks, Morse & Co., was the presentation, by his associates, of a diamond stud. Mr. Bird assumes his new duties on August 1.

F. E. Greene, formerly with the Westinghouse Machine Company, has been appointed Superintendent Gas Engine Department, Fairbanks, Morse & Co., Beloit, Wis., to succeed J. D. Bird, resigned.

D. Petri-Palmedo, mechanical expert, who does machine designing, translating of foreign technical literature, preparing of patent-office drawings, etc., is now located at Room 232, 280 Broadway, New York City.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situation.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper list free. E. G. Smith Co., Columbia, Pa.

Let us quote you on gear cutting. Iroquois Machine Co., Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

We desire a few more machines or specialties to manufacture. Box 423, Troy, N. Y.

Machines designed and built. Walter S. McKinney, M. E., Broadway, Flushing, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Special machinery to order. Catalog of small engines and boilers and engine castings 10c. Sipp Elec. & Mach. Co., Paterson, N. J.

We will do your manufaturing for you; well established and equipped foundry and machine shop. Emmert Mfg. Co., Waynesboro, Penn.

Well established concern will pay royalty for several good patented machines or tools to manufacture. Emmert Mfg. Co., Waynesboro, Penn.

A well equipped machine shop in New England of sufficient capacity to employ 200 men is in a position to take on more work. Box 186, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Men who operate grinding machines would read H. Darbyshire's 'Precision Grinding," a $2 book that's worth ten times that money to you. Hill Pub. Co., 505 Pearl St., New York.

Design wanted for a practical, light portable motor, using steam or compressed air; can be of either the rotary or recipocating type; give full particulars and send blue print. Box 230, AMERICAN MACHINIST.

An up to date modern foundry equipped to make large work, would like to get in touch with machinery builders who are in need of heavy gray iron castings; low freight rate to all eastern points. Address Box 212, AM. M.

A well equipped machine shop and foundry desires to add to its output by the manufacture of articles of brass and iron which would find a ready sale in the south; correspondence invited. Box 122, AMER. MACH.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

First-class machine tool company with large capitalization wishes to enter into relation with machine tool manufacturers to undertake the sole agency for Germany. Address F. M. V., 860 care Rudolf Mosse, Frankfort-on-Main, Germany.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers, 146 West 56th Street.

Advice; mechanical, practical and technical; tell me your needs, I'll tell you the cost; lowest estimates given on fine tools, dies and presses for sheet metal goods production; have you my books? Jos. V. Woodworth, M. E., Arbuckle Building, Brooklyn, N. Y. U. S. A.

Arrange with us to do your manufacturing; we are thoroughly equipped for all classes of machine work, including screw machine and punch parts, tools, jigs, etc.; we also design and build to order special and experimental machinery. Forest City Specialty Manufacturing Co., Rockford, Illinois.

Planer hands—C. Ashley, a planer hand, has written a book "Planer Kinks," for practical planer men and every planer hand should get it; $1 postpaid. Hill Pub. Co., 505 Pearl St., New York.

Wanted gas engines built; one of the largest and oldest gas engine firms—located west—desires to make contract with eastern manufacturer to build marine gas engines up to 16x18 multiple cylinder; patterns, drawings and initial supervision furnished; must have capacity for $250,000 to $350,000 annually. Box 207, AMERICAN MACHINIST.

We have a special proposition for a few bright, energetic mechanics, such as foremen, draftsmen or machinists in different sections of the country; no canvassing or selling of any kind, and, while not interfering with your regular work, pays well for the time taken; we want only practical men who can be depended on to give the little time required each week; further particulars on application. Box 102, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS

General foreman desires change; automobiles or light machinery. Box 251, AM. M.

NEW JERSEY

Foreman, practical machinist, wishes to make a change. Box 238, AMER. MACHINIST.

General foreman, excellent toolmaker and machinist, designer of labor-saving devices, open for engagement. Box 224, AMER. MACH.

Thoroughly experienced export manager desires position with large manufacturing concern which wishes to build up its export trade; 15 years in the business. Address "R. O. P.," AMERICAN MACHINIST.

Position as European representative or salesman wanted by a German expert who has introduced and sold American machinery, tools, hardware and similar technical lines in Europe and other parts of the world; knows American business methods and is a thorough English student. Address "C. D.," AM. M.

NEW YORK

Can act as engineer and New York representative as side line. G. E. Hackett, M. E., 71 Nassau St., New York.

Draftsman desires position in or about New York; expert tracer and detailer; salary $21; A-1 references. Box 236, AMER. MACHINIST.

Wanted—A position as chief engineer, mechanical and electrical; can furnish the best of references by inquiries. Box 183, AM. M.

Graduate, 7 years' experience as draftsman and designer on engine, boilerwork, and mining machinery, seeks position. Box 248, AMERICAN MACHINIST.

A-1 mechanic, inventive and organizing ability, experienced on high-grade interchangeable work; good manager of men, wishes to change. Box 249, AMER. MACH.

Wanted by a German 23 years of age, graduate of German technical school, position as draftsman; 7 months' experience in this country. Box 237, AMER. MACHINIST.

Foreman of toolmaking department of a large manufacturing company; thoroughly experienced in designing and building jigs, fixtures and special tools for manufacturing high grade interchangeable work, systematic, executive ability; can produce best results; desires position as assistant superintendent or foreman; location immaterial; references. Address Box 234, AMERICAN MACHINIST.

OHIO

Tool and die maker wants position; experienced in handling men; Canada or Western New York. Address "M. E. J.," AM. MACH.

Chief draftsman machine tools wants change; technical graduate; 32 years and married; A-1 references. Box 215, AM. M.

First-class mechanical engineer graduated in Germany, at present employed as designer with four years' shop and eight years' drawing room experience on machine tools, wishes to change as assistant superintendent. Box 245, AMERICAN MACHINIST.

PENNSYLVANIA

Two good mechanics would like to work in co-operation as salesman and erector. "Erector," AMERICAN MACHINIST.

Tool and special automatic machinery designer wants position as tool designer, tool room foreman, etc; first-class mechanic, age 30; at present employed as chief draftsman; A-1 references. Box 250, AMER. MACHINIST.

Universal grinder; young man thoroughly experienced in accurate and commercial universal grinding and a good repair machinist experienced in automobile and bearing work would like to change position. Box 247, AMERICAN MACHINIST.

A young man of 12 years' experience desires a position as general foreman of wire mill, present position foreman of shape wire drawing department of a large manufacturing concern; desires change; best of references. Box 253, AMERICAN MACHINIST.

Commercial engineer; a thorough business man with technical training desires an executive position in the business end of a manufacturing concern; experienced and has "made good"; best of references; details of experience on request. "Commercial," AM. M.

Wanted—Position as advertising manager with manufacturing concern, preferably in mechanical field, by a woman with years of experience in that capacity and field, with large, representative houses; thoroughly competent to handle printing, illustrating and the preparation of copy; at present employed; reasons for seeking change made known to prospective employer. Box 103, AMERICAN MACHINIST.

RHODE ISLAND

General superintendent solicits correspondence from companies desiring the services of a practical mechanic and executive; highest references. Box 233, AMER. MACH.

Are you looking for an executive? Have had 20 years experience as superintendent, purchasing agent and intermediate mechanical positions; at liberty Sept. 1. Address Box 235, AMERICAN MACHINIST.

VERMONT

Advertiser will be open for engagement as works manager or mechanical engineer on September 1. Address Box 170, AMER. MACH.

WISCONSIN

Mechanical engineer and draftsman; 29 years old, married, with 5 years' experience in boilers, steam turbines, water turbines and governors, as well as shop experience, wishes position. Box 211, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Machinists wanted; four good floor and vise hands; two lathe and planer hands; one Gisholt lathe hand; must be first-class all around mechanics; open shop; no labor troubles; good wages; Los Angeles. Answer care F. Charles, 505 Grosse Bldg.

Wanted—At Throop Polytechnic Institute, Pasadena, Calif., instructor in pattern and machine shop work, also instructor in mechanical drawing and machine design; practical experience and technical training essential; representative now in the East can interview applicants. Box 252, AMER. MACH.

CANADA

Wanted—Toolmakers experienced on fixtures, dies and gages. Address with full particulars as to experience, wages required, giving definite time as to commencing work. Ross Rifle Company, Quebec, Canada.

CONECTICUT

Wanted—First-class all-around machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Tool and die makers wanted; a number of first-class die makers on punching, bending and blanking dies for sheet-brass and steel work; also toolmakers, especially on cutting tools, such as millers, reamers, taps, etc.; steady employment for the right parties. Apply at once to The Yale & Towne Mfg. Company, Stamford, Conn.

ILLINOIS

Wanted—First-class salesman for high speed tools; must be practical man, capable of demonstrating tools in shops, factories, etc Box 210, AMERICAN MACHINIST.

Wanted—A designer experienced on automatic punch press and die work for small parts; concern is progressive and up-to-date; position permanent for right man; in replying, state experience and also give age, nationality and salary expected, together with references; correspondence confidential. Box 246, AMERICAN MACHINIST.

INDIANA

Wanted—Five good toolmakers and six lathe men; good wages; steady employment. The Western Motor Co, Logansport, Ind.

MINNESOTA

Wanted—First-class machinists on lathes, planers, floor and vise work; non union men only; yearly contracts at 30c. and 40c. an hour. Diamond Iron Wks., Minneapolis, Minn.

MISSOURI

Few first-class die makers, highest wages, open shop; references required. Box 214, AMERICAN MACHINIST.

General manager wanted by company manufacturing light machinery, has fine equipment and good business; salary commensurate with ability; it is desired that he take about $5000 interest in company; communications held confidential. Box 244, AM. M.

NEW JERSEY

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—Mechanical draftsman on small tool and jig work; one experienced in laying out cams for Brown & Sharpe automatic screw machine preferred; state age, experience, and wages expected. Box 241, AM. M.

NEW YORK

Wanted—First-class toolmakers on tools, jigs, and fixtures. Boxes 7 and 8, Syracuse, N. Y.

Wanted—Draftsman, experienced in machine equipment; in replying state age, married or single, if now employed, experience and wages expected. Box 218, AMER. MACH.

Wanted—Assistant machine shop foreman familiar with latest methods of reduction, valves and fittings; must have good executive ability to get out work quickly; permanent position for right man. Box 219, AMER. MACH.

Machinery salesman wanted by an old established New York house to travel principally; must be thoroughly experienced, familiar with handling second-hand as well as new machine tools. Box 239, AM. MACH.

Energetic salesman by large house for special lines of machinery and tools; must be well connected with the trade and be able to build up very promising business; practical knowledge of machinery essential; all information confidential. Box 240, AM. MACH.

Toolmaker; a first-class practical toolmaker, familiar with all kinds of tool work and shop practice; experienced in handling men; a good position for the right man; write, stating age, experience both as a mechanic and in handling men, and salary expected. Address "Tools," 41 W. 34th St., New York.

OHIO

Wanted—Experienced punch and shear draftsman; state qualifications, age, and salary expected. Box 70, AMER. MACHINIST.

Wanted—Operator for Jones & Lamson latest type machine; state age, experience and wages. Address Box 243, AMER. MACHINIST.

Wanted—Several draftsman familiar with steam hammer designing; state age, experience, and salary expected. Box 71, AM. M.

To a live young, practical foundry foreman, we will pay $100 per month and 10 per cent. of the profits payable weekly; capacity 25 tons per day, 10 molding machines, besides heavy floor work. Address Box 232, AM. M.

Wanted—Machinists and operatives; we are about to remove our machine shops from Kent, Ohio, to Franklin, Pa. Some of our present employees own their homes in Ohio and do not wish to leave them so are seeking other permanent employment here. We therefore offer to qualified persons positions in our present plant from now until about October first and permanent positions to those who then move with the plant to Franklin, Pa. To such persons who accept service with us under the present conditions, we will guarantee the best permanent positions when our Franklin plant is in operation, giving the preference even over present residents of Franklin. Franklin is a beautiful little city of 12,000 inhabitants with excellent schools and other facilities. We have no labor troubles in our shops nor have we ever had any. Address communications to C. L. Winey, Works Manager, Kent, Ohio.

PENNSYLVANIA

Wanted—Lathe, planer and boring mill hands. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Foreman for gear cutting department; must have experience; apply with particulars to R. D. Nuttall Co., Pittsburg, Pa.

Technical graduate to teach machine design and mechanical drawing; location Western Pennsylvania; salary $1200 per year. Box 231, AMERICAN MACHINIST.

Wanted—Several good tool and die makers at once; also men who have had experience in experimental work on typewriters, adding machines, etc. The Adder Machine Co., Wilkes-Barre, Pa.

We are just completing the fitting up of a modern machine manufacturing plant, and invite applications for employment from machinists, pattern makers and molders; steady employment and good wages for reliable and desirable workmen; when writing give full details of experience. The Shepherd Engineering Co., Williamsport, Pa.

First class molder with experience on medium weight high grade iron machinery castings; to the right man if familiar with melting iron, and with ability to handle men, position of assistant foreman is open; to receive consideration give full details of experience, for whom you have worked, length of time, class of work, and wages received. All communications will be considered confidential. Box 217, AMERICAN MACHINIST.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery; good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, O.

For Sale or will lease to responsible parties modern equipped brass foundry, located in Brooklyn. Address "B. F.," AMER. MACH.

For Sale—Ten volume library covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

One 10x10x12 duplex steam pump; one 10x14x12 Rand air compressor; one No. 3 Toledo punch press; two hydraulic presses, will take in material 35"x35". Sbartle Brothers, Middletown, O.

One 35-horse-power Backus gas engine equipped with a self-starting device, in service less than six months, cost $1800; will sell very reasonably. Bowman Auto Company, 225-231 West 49th Street.

For Sale—One 35 kw., 125 volt, Westinghouse, direct current, direct connected generator, and 10x10 Ideal engine; absolutely good as new; $1000 f. o. b. cars Minneapolis Janney, Semple, Hill & Co., Minneapolis, Minn.

For Sale—One 12"x16" center crank automatic engine in good condition; diameter of crank shaft 4⅞"; size of driving wheel 40"x15"; size of governor wheel 58"x13"; Bay State Iron Works make; only reason for replacing it was increase in power plant. Erie Foundry Company, Erie, Pa.

For Sale—An established and very profitable manufacturing plant employing about 60 men making iron working machinery and tools; the business has grown about 50 per cent. each year, and offers exceptional opportunities for greater increase in the future; good reasons for selling. Address "Manufacturer," AMERICAN MACHINIST.

For Sale—Sets of patterns for pulley turning and boring lathe, sizes 30", 42" and 60", with detail working drawing, and with some special boring bars and tools; these patterns were originally purchased from M. C. Hendley, Indianapolis, Ind.; a bargain for anyone who wishes to take up this line of goods to manufacture them; price $3000. Goldens' Foundry & Machine Co., Columbus, Ga.

Alphabetical Index to Advertisers

PAGE

Abrasive Material Co.....126
Acme Machinery Co..38 and 177
Adams Co.....101
Albro-Clem Elevator Co.....148
Almond Mfg. Co., T. R.....161
Alteneder & Sons, Theo.....38
American Emery Wheel Wks.126
American Gas Furnace Co...95
American Pulley Co.....121
American School of Correspondence.....91 & 137
American Tool & Machine Co.166
American Tool Works Co. 8 and 170
American Tube & Stamp'g Co.183
American Watch Tool Co....120
Ames & Co., B. C.....156
Armstrong-Blum Mfg. Co....157
Armstrong Bros. Tool Co....76
Athol Machine Co.....134
Automatic Machine Co.....94

Backus Water Motor Co.....145
Baird Machine Co.....100
Baker Bros.....135 and 158
Baker, S. S.....166
Baldwin Chain & Mfg. Co...148
Baldwin Steel Co.....67
Bardons & Oliver.....92
Barnes Co., B. F.....122
Barnes Co., W. F. & John....14
Barnett Co., G. & H....4th cover
Bartlett, E. E.....111
Bath Grinder Co.....9
Baush Mach. Tool Co..3d cover
Bay State Stamping Co.....143
Beaman & Smith Co..15 and 160
Beaudry & Co.....118
Becker-Brainard Milling Machine Co.....23
Bemis & Call Hardw. & Tool Co.....118
Bertsch & Co.....166
Besly & Co., Chas. H.....120
Best Co., L.....126
Bethlehem Fdry. & Machine Co.....173
Bethlehem Steel Co.....57
Bickford Drill & Tool Co.....10
Bignall & Keeler Mfg. Co....169
Bilgram, Hugo.....38
Billings & Spencer Co.....174
Binsse Mach. Co.....38
Birdsboro Steel Fdry. & Machine Co.....110
Blaisdell Machinery Co.....132
Blanchard Machine Co.....115
Blair Tool & Machine Wks..123
Bliss Co., E. W.....25
Blood Bros. Machine Co....157
Blount Co., J. G.....32

PAGE

Boker & Co., Hermann.....65
Boston Gear Works.....146
Box & Co., Alfred.....150
Boynton & Plummer.....152
Bradford Machine Tool Co....5
Bradley & Son, C. C.....174
Bridgeport Safety Emery Wheel Co.....124
Bristol Co.....4th cover
Bristol, Wm. H.....38
Brown & Co., R. H.....161
Brown Co. The H. B.....157
Brown Engine Works, C. H...173
Brown Hoisting Machry. Co..151
Brown & Sharpe Mfg. Co.....51
Brugaker & Bros., W. L.....143
Buffalo Forge Co.....4th cover
Bullard Mach. Tool Co., 37 and 170
Burke Electric Co.....145
Burke Machinery Co.....166
Burr & Sons, John T.....166
Burroughs Co., Chas.....166
Bury Compressor Co.....132
Butterfield & Co.....106
Byram & Co., Inc.....138

Caldwell & Son Co., H. W....151
Carborundum Co.....30
Card Mfg. Co., S. W.....24
Carpenter Tap & Die Co., J. M.....116
Carver File Co.....176
Case Mfg. Co.....150
C & C Electric Co.....142
Chadwick & Trefethen.....156
Chambersburg Engineering Co. 175
Champion Tool Works Co....116
Chesterman & Co., Ltd., Jas..136
Chicago Flexible Shaft Co..108
Chicago Machine Tool Co....111
Chicago Pneu. Tool Co.....132
Chicago Rawhide Mfg. Co....148
Chisholm & Moore Mfg. Co.153
Cincinnati Ball Crank Co....156
Cincinnati Electrical Tool Co. 77
Cincinnati Machine Tool Co.. 97
Cincinnati Milling Mach. Co. 6 and 7
Cincinnati Planer Co.....26
Cincinnati Shaper Co.....186
Clark Auto. Telephone Switchboard Co.....104
Clark Cast Steel Cement Co..173
Clark, D. W.....173
Clark, Jr. & Co., Jas.....72
Clayton Air Compressor Wks. 133
Cleveland Auto. Mach. Co.... 18
Cleveland Cap Screw Co....136

PAGE

Cleveland Crane & Car Co...150
Cleveland Planer Works.....105
Cleveland Stone Co.....126
Cleveland Twist Drill Co.... 74
Cleveland Wire Spring Co....158
Cling-Surface Co.....145
Clough, R. M.....133
Coates Clipper Mfg. Co.....176
Cochrane-Bly Co..... 91
Coes Wrench Co.....20 and 21
Colburn Machine Tool Co....117
Cook Co., Asa S.....173
Crescent Forgings Co.....154
Crocker-Wheeler Co.....141
Crosby Steam Gage & Valve Co.....171
Cullman Wheel Co.....148
Cumberland Steel Co.....156
Curtis & Co., Mfg. Co.....150
Curtis & Curtis Co.....156
Cushman Chuck Co.....160

Dallett Co., Thos. H.....174
Davis Machine Co., W. P.... 86
Desmond-Stephan Mfg. Co...125
Detrick & Harvey Mach. Co...122
Dexter Machine Co.....157
Diamond Chain & Mfg. Co....167
Diamond Saw & Stamping Works.....173
Dickinson, Thos L.....126
Diehl Mfg. Co.....143
Dill Slotter People.....121
Dixon Crucible Co., Joseph..119
Dodge & Day.....176
Dreses Machine Tool Co....113

Earle Gear & Mach. Co.....148
Eastern Machinery Co.....150
Eberhardt Bros. Mach. Co...148
Eck Dynamo & Motor Co....143
Economy Drawing Table Co..123
Electric Controller & Supply Co.....140
Elliott Chemical Works.....138
Elmes Engineering Works, Chas. F.....117
Erie Foundry Co.....164
Errington, F. A.....161
Estep & Dolan.....157
Evans Friction Cone Co....120
Excelsior Needle Co.....109

Fairbanks Co.....158
Farrel Fdry. & Mach. Co....129
Fawcus Machine Co.....148
Fellows Gear Shaper Co..... 89
Felton, Sibley & Co.....166
Field, Chas. H.....138
Firth-Sterling Steel Co.....131
Fitchburg Machine Works... 31

PAGE

Foote Bros. Gear & Machine Co.....148
Foote-Burt Co., The..... 99
Fosdick Machine Tool Co.... 16
Foster-Kimball Machine Co.. 183
Franklin Mfg. Co., H. H.....177
Frevert Machinery Co.....150
Fulton Fdry. & Machine Co..122

Gang Co., Wm. E.....157
Garden City Fan Co.....122
Gardner Machine Co.....126
Garvin Machine Co.....180
General Electric Co.....139
General Pneumatic Tool Co..151
Geometric Tool Co..... 25
Gisholt Mach. Co.....185
Gleason Works.....4th cover
Globe Machine & Stamping Co.....130
Goldschmidt Thermit Co....128
Goodell Pratt Co....78 and 79
Gorton Machine Co., Geo....114
Gould & Eberhardt.....112
Graham Mfg. Co.....158
Grant Gear Works.....146
Grant Mfg. & Mach. Co.....122
Gray Co., G. A.....38
Gray & Prior Machine Co....158
Greaves, Klusman & Co.....123
Greenfield Machine Co.....125

Hammacher, Schlemmer & Co. 57
Hanna Engineering Works...154
Hardinge Bros..... 94
Harrington, Son & Co., Edw.112
Harrison & Knight Mfg. Co..153
Hart & Cooley Co.....115
Hart Mfg. Co.....159
Heald Machine Co.....167
Hendey Machine Co..... 59
Henley Publishing Co., N. W. 69
Henry & Wright Mfg. Co....109
High Duty Saw & Tool Co.... 67
Hill, Clarke & Co., Inc. 111 and 155
Hill Publishing Co..... 38
Hisey-Wolf Machine Co..... 75
Hobbs, Clinton E.....150
Hoefer Mfg. Co.....114
Hoggson & Pettis Mfg. Co..160
Hopkinson Machine Works..134
Horsburgh & Scott Co..4th cover
Horton & Son Co., E.....160
Howson & Howson.....156
Hunt & Co., Robt. W.....176
Hurlbut-Rogers Machine Co..179

Independent Pneumatic Tool Co.....164

PAGE

Industrial Oxygen Co.....156
Ingersoll-Rand Co.....133
Ingersoll Milling Mach. Co..113
International Correspondence Schools 93
International Specialty Co..126
Iroquois Machine Co.....148

Jacobs Mfg. Co.....162 and 163
Jacobson Mach. Mfg. Co....145
Jantz & Leist Electric Co...143
Jenkins Brothers.....145
Johnson Mach. Co., Carlyle.. 88
Jones & Lamson Mach. Co. 12, 13 and 38
Joyce-Cridland Co.....167

Kelly Co., R. A.....166
Kempsmith Mfg. Co..... 22
Kendrick & Davis.....136
Kent & Co., Edwin R.....129
Kern Machine Tool Co..... 90
Keyless Lock Co.....157
Keystone Steel Casting Co..130
Keystone Mfg. Co.....159
Keystone Watch Case Co....170
Kinsey Co., The E A.....171
Knight Machinery Co., W. B.158

Landis Machine Co.....158
Landis Tool Co..... 53
Lang Co., G. R.....159
Lapointe Mach. Tool Co..... 97
Lea Equipment Co.....182
Le Blond Machine Tool Co. R. K. .....73 and 107
Le Count, Wm. G.....160
Lincoln Motor Works Co....143
Link-Belt Co.....178
Lodge & Shipley Machine Tool Co. 4
Long & Allstatter Co.....115
Lucas Machine Tool Co.....184
Lufkin Rule Co.....136
Lumen Bearing Co.....138
Lunkenheimer Co., The.....118
Lyon Metallic Mfg. Co.....178

Macdonald & Macdonald....156
Main Belting Co.....114
Mfg. Equip. & Eng. Co..... 32
Manufacturers Foundry Co..130
Maris Brothers 150
Marsh, A.....114
Marshall & Huschart Machinery Co. 171
Marston & Co., J. M.....157
Mass. Saw Works..... 27
Matthews, Hugh 145
McCabe, J. J.....118 and 170
McDowell, Stocker & Co....170
Mc Innes Steel Co.....138
McLeod & Henry Co.....169
Mechanics Machine Co.....122
Merrell Mfg. Co.....123
Merritt & Co.....173
Merritt, Jos.....116
Millers Falls Co.....122
Milton Mfg. Co..... 63
Miner & Peck Mfg. Co.....158
Mittineague Paper Co.....135
Moline Tool Co.....136

PAGE

Moore Co., Franklin.....151
Morris Fdry. Co., Jno. B.... 33
Morse Chain Co..... 92
Morse Twist Drill & Machine Co. 55
Morse, Williams & Co. 148
Morton Mfg. Co.....155
Mossberg Wrench Co.....103
Motch & Merryweather Machinery Co. 171
Mueller Mach. Tool Co.....117
Mumford Co., E. H.....169
Mutual Machine Co.....157

National-Acme Mfg. Co.....186
National Machine Co.....123
National Machine & Tool Co.176
National Machinery Co.....176
New Britain Machine Co....121
New Haven Mfg. Co.....105
New Machine Co.....157
New Process Rawhide Co....147
Newton Machine Tool Works 11
Nicholls, W. S.....150
Nicholson File Co..... 17
Nicholson & Co., W. H..... 81
Niles-Bement-Pond Co., 3, 36, 172
Northern Electrical Mfg. Co.140
Northern Engineering Works.150
Norton Co. 71
Norton Grinding Co..... 70
Nuttall Co., R. D.....146
Nutter, Barnes & Co..... 99

Obermayer Co., The S.....138
Oesterlein Machine Co.....173
O. K. Tool Holder Co.....166
Owen Machine Tool Co..... 22

Page-Storms Drop Forge Co.144
Parker Co., Chas. 167
Parker, C. L.....156
Patterson, Gottfried & Hunter, Ltd. 176
Pawling & Harnischfeger....150
Paxson Co., J. W.....138
Philadelphia Bourse.....168
Philadelphia Gear Works...146
Phillips-Laffitte Co., The....138
Pike Mfg. Co..... 63
Pittsburg Auto. Vise & Tool Co. 134
Plunket, J. E.....134
Poole Co., J. Morton.....101
Potter & Johnston Mach. Co. 59
Powell Co., The Wm.....157
Pratt Chuck Co.....164
Pratt & Whitney Co...34 and 35
Prentice Bros. Co..... 29
Prentiss Tool & Supply Co., 154 and 170
Prentiss Vise Co.....136
Prosser & Son, Thos.....130

Queen City Mach. Tool Co...102

Rahn-Carpenter Co.....159
Ransom Mfg. Co.....127
Reece Co., E. F.....122
Reed Co., Francis.....160
Reed Mfg. Co.....134
Reichhelm & Co., E. P..4th cover

PAGE

Reinforced Brazing & Mach. Co. 169
Remington Oil Engine Co....145
Rhodes, L. E.....160
Rhodes & Sons, J. E..... 85
Rich, J. & G.....136
Ridgway Dynamo & Engine Co. 144
Risdon Tool Wks.....176
Rivett-Dock Company....3d cover
Rivett Lathe Mfg. Co..3d cover
Robertson Mfg Co.....168
Rockford Machine Tool Co...107
Rock Island Tool Co.....134
Rockville Machine Co.....157
Rockwood Mfg. Co.....151
Rogers Works, John M.....127
Rogers & Hubbard Co.....138
Roth Bros. & Co.....144
Rowell Co., W. G.....138
Royersford Fdry. & Mach. Co.123

Sackmann, W. L.....156
Safety Emery Wheel Co..... 80
Saunders' Sons, D.....159
Sawyer Gear Works.....146
Sawyer Tool Mfg. Co.....135
Schellenbach & Darling Tool Co. 117
Schieren & Co., Chas. A..... 84
Schumacher & Boye..... 9
Schwerdtle Stamp Co.....156
Scranton & Co., The.....157
Sebastian Lathe Co.....115
Sellers & Co., Wm..... 28
Seneca Falls Mfg. Co.....165
Shelby Steel Tube Co.....123
Shultz Belting Co..... 93
Sibley Machine Tool Co..... 95
Skinner Chuck Co.....160
Skinner Shipbuilding & Dry Dock Co. 150
Slate Machine Co., Dwight... 98
Sloan & Chace Mfg. Co.....181
Slocomb Co., J. T.....180
Smith Countershaft Co..... 31
Smith Foundry Supply Co., J. D. 128
Smith & Mills.....157
Soltmann, E. G.....136
Spacke Machine Co., F. W...132
Spicer Universal Joint Mfg. Co. 157
Sprague Electric Co.....142
Springfield Machine Tool Co.. 15
St. Mary's Machine Co.....145
Standard Connecting Rod Co.175
Standard Engineering Works.156
Standard Gauge Steel Co....149
Standard Roller Bearing Co.159
Standard Tool Co..... 87
Standard Welding Co.....102
Stark Tool Co.....159
Starrett Co., L. S..... 83
Steptoe Shaper Co., John....173
Stevens, Frederic B.....128
Stoever Fdry. & Mach. Co..175
Stow Mfg. Co.....144
Struthers-Wells Co.....145
Sturtevant Co., B. F.....175
Superior Corundum Wheel Co.126
Sweet & Doyle Valve Co....156
Swaine Mfg. Co., The Fred J.161

PAGE

Tabor Mfg. Co.....130
Taylor & Fenn Mach. Co.... 96
Taylor-Wilson Mfg. Co.....149
Tindel-Morris Co.....100
Toledo Machine & Tool Co..135
Toomey, Frank.....170
Triumph Electric Co.....144
Turner Brass Works.....156
Turner Mach. Co.....143

Underwood & Co., H. B.....142
Union Mfg. Co.....160
Union Twist Drill Co..... 61
United Engineering & Fdry. Co. 110
U. S. Electrical Tool Co....168
United States Metallic Packing Co. 108
Universal Drafting Machine Co., ...137

Van Dorn & Dutton Co.....146
Vandyck Churchill Co.....174
Veeder Mfg. Co.....136
Vitrified Wheel Co.....124
Von Wyck Machine Tool Co.106

Wagner Electric Mfg. Co....143
Walcott & Wood Machine Tool Co. 103
Wallace Supply Co.....173
Waltham Machine Wks.....157
Waltham Watch Tool Co....176
Ward & Sons, Edgar T.121 & 128
Warner Instrument Co.....123
Warner & Swasey Co.....184
Waterbury Farrel Fdry. & Mach. Co. 116
Waterbury Gear Co.....148
Watson-Stillman Co.....104
Wells Bros. Co..... 73
Wells & Son Co., F. E..... 82
Western Tool & Mfg. Co....168
West Haven Mfg. Co.....127
Westinghouse Elec. & Mfg. Co 140
Westmacott Gas Furnace Co.176
Weston Elec. Instrument Co.145
Whitcomb-Blaisdell Machine Tool Co. 19
Whitman & Barnes Mfg. Co. 119
Whitney Mfg. Co..... 49
Whiton Machine Co., D. E....165
Wiebusch & Hilger.....136
Wiley & Russell Mfg. Co.... 90
Williams Valve Mfg. Co., D. T. 152
Wilmarth & Morman Co.....127
Windsor Machine Co..... 96
Winkley Co.....159
Wood's Sons Co., T. B.....137
Wood Turret Machine Co., The 155
Woodward & Powell Planer Co. 98
Worcester Machine Screw Co.156
Wormer Machinery Co., C. C.171
Wrigley Co., Thos.....126
Wyke & Co., J.....136
Wyman & Gordon Co..4th cover

Yale & Towne Mfg. Co.....153

Classified Index to Articles Advertised

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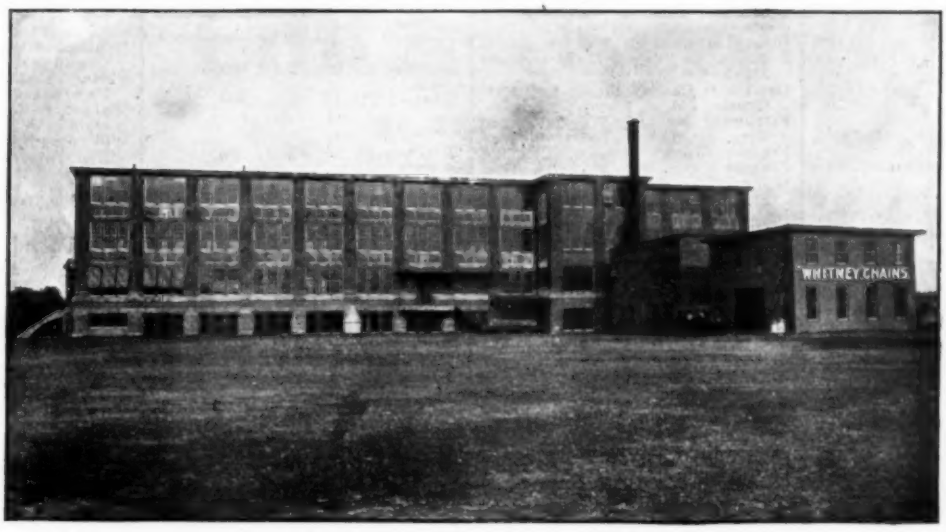

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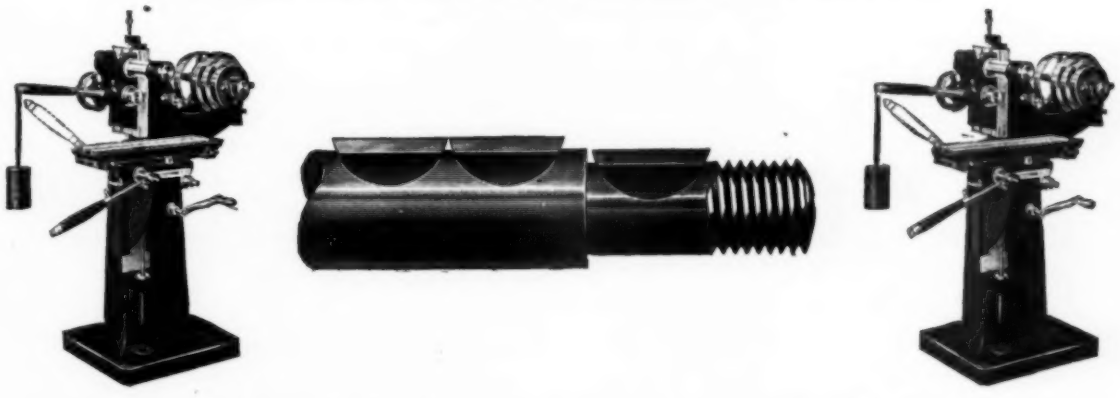

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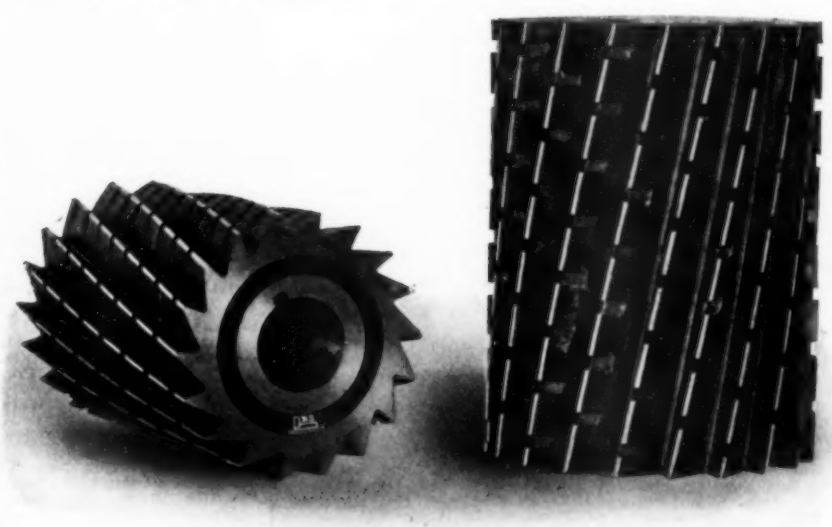

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Pratt & Whitney Co., Hartford, Conn.

Cutting-off Tools—*Continued.*
Western Tool & Mfg. Co., Springfield, Ohio.

Cyclometers
Veeder Mfg. Co., Hartford, Ct.

Diamond, Tools
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Superior Corundum Wheel Co., Waltham, Mass.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Globe Machine & Stamping Co., Cleveland, Ohio.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.
Risdon Tool Works, Waterbury, Conn.
Swaine Mfg. Co., Fred J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, Ohio.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Risdon Tool Works, Waterbury, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

Drawing Materials
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Universal Drafting Mach. Co., Cleveland, O.

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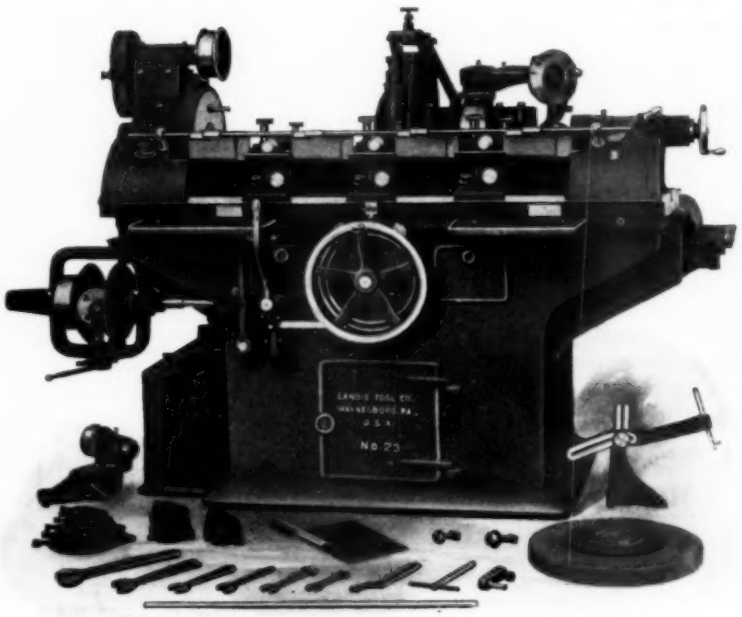
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Slate Mach. Co., Dwight, Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks, Co., Cin. O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Dallett Co., Thos. H., Phila., Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric
Chicago Pneumatic Tool Co., Chicago, Ill.
Dallett Co., Thos. H., Phila. Pa.
Independent Pneumatic Tool Co. Chicago, Ill.

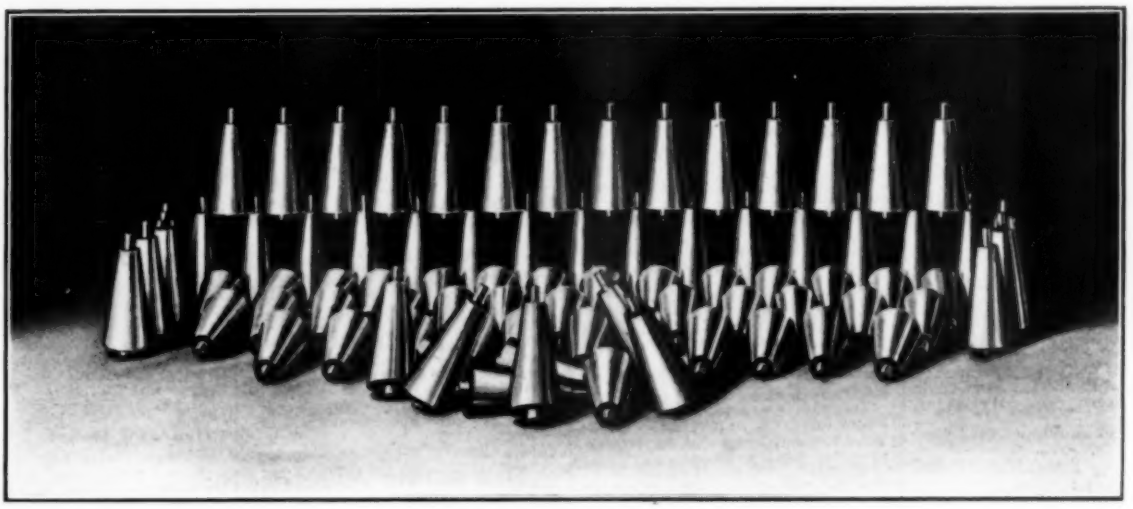


12" swing, 42" between centers.

LANDIS Grinding Machines

have great Productive Capacity. The belts being wide and the speeds proportionate — the proper condition is readily obtained for maximum output.

Landis Machines have ingenious mechanical devices and being so constructed, they prove their utility as a manufacturing tool when put in service. Below we give an example of Harveyized Conical Rolls, such as are used in railroad construction work. This job was done on a Landis Plain Grinding Machine for one of the largest firms in the country, who had practically given up obtaining such results as they now realize.



HARVEYIZED CONICAL ROLLS.

Diameter large end 4⅝"; Dia. small end 2 11/16". Length of taper 8⅞". .027 removed from taper, gauge fit, in 4½ minutes. End bearings .015" removed in 1 minute; total 5½ minutes.

LANDIS TOOL COMPANY, Waynesboro, Pa., U.S.A.

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
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McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Machine Co., The, Hartford, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York. delphia, Pa.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
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Cincinnati Elec. Tool Co., Cin., O.
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Niles-Bement-Pond Co., New York.
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Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros., Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

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Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
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Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.

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Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
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Patterson, Gottfried & Hunter, Ltd., New York.
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Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Robertson Mfg. Co., Buffalo, N. Y.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Mach. Co., Hartford, Conn.
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Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
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Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
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Drills, Hand

Coates Clipper Mfg. Co., Worcester, Mass.
Cincinnati Electrical Tool Co., Cincinnati, O.
Dallett Co., Thos., H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

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Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Clayton Air Compressor Works, New York.
Dallett Co., Thos. H., Phila., Pa.
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Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

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Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hisey-Wolf Mach. Co., Cin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co, Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

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Northern Electrical Mfg. Co., Madison, Wis.

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Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
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Sturtevant Co., B. F., Hyde Park, Mass.
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Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
Garden City Fan Co., Chicago, Ill.
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Storage in a Large Concrete Machine Shop

Fire-resisting Racks, Boxes and Other Storage Devices in the Plant of the United Shoe Machinery Company, at Beverly, Massachusetts

BY L. P. ALFORD

The question of storage systems and devices for material and product is one which is too often slighted in manufacturing plants, for while there results economy both of time and material from their use, it is difficult to estimate or foretell the saving when the matter is up for discussion; thus it is an element of factory organization which is often allowed to drift along without intelligent action, as it is considered an unnecessary refinement or a detail of system falling in the despised class of red tape.

The greater the variety of material in use the larger the number of pieces made, the wider the variations of size between different associated parts, the more complex this question of storage becomes, and at the same time the more necessary is the solution. When the preliminary analyses were compiled by the engineers of the United Shoe Machinery Company in regard to storage, they found that there were upward of 70,000 different kinds of parts under different list numbers to be cared for. Under each list number there might be from 10 to 100,000 pieces to be stored, and a piece might be a small No. 4-56 screw, or it might be a casting weighing several hundred or even a thousand pounds. Many parts were associated by list numbers which differed widely in size, yet must be stored in bins or racks in consecutive order as far as possible. In addition to all these finished parts were the same parts in process, the tools to manufacture them, and the raw materials from which they were made.

The buildings were constructed of reinforced concrete, no fire insurance was to be carried upon them or their contents; and it was therefore illogical to construct the racks, bins, boxes and other storage devices of anything except fire-resisting materials. This, of course, called for metal construction. The existing factories had practically nothing which was available, for their constructions in regard to storage were mainly of wood, and even if it was desired to make use of them, the cost of taking them down, transporting and setting them up again in the new plant would have been much greater than their value.

Metal racks, boxes, and storage devices in general had been used, but very little in machine shops up to this time, and the experience of obtaining information as to what others had done was unsatisfactory. The problem was therefore taken up as a whole, and following the preliminary analyses there were designed all kinds of storage devices, mainly from metal. Specifications were written for these various parts, contracts were let, and the devices were installed and put into use. Two figures will suffice to show the extent of the work carried on. The original contract for finished-part storage was sufficient to care for over 40,000 cubic feet of box volume. Today practically all of the storage for this plant, which employs nearly 3000 men, is cared for by these means. It is the purpose of this article to describe briefly and illustrate these various storage systems and devices, for there are many points of value in this method of construction, aside from the fire-resisting element. They will be discussed under the following general headings: Raw-material storage; Parts-in-process storage; Finished-parts storage; Erecting-floor storage; and Tool storage.

FIG. 1 BAR STEEL RACKS

FIG. 2

Raw-material Storage

Under this heading will be considered storage for bar stock, sheet stock, castings, forgings and wire. General supplies will not be considered as their methods of handling present no unusual features.

Bar-stock Racks

We call attention to the two half-tones, Figs. 1 and 2, showing two different types of racks for holding bar steel. The design of Fig. 1 was made for the Beverly plant, while the design in Fig. 2 was developed at one of the older factories of the company, and the racks there photographed were removed from the factory where they were in use and set up at Beverly. It is needless to point out that the racks as shown by Fig. 1 are cheaper, more economical of storage volume and generally more satisfactory than the others. Throughout all these racks an effort was made to use materials which could easily be obtained in the open markets, and which were inexpensive. To meet these conditions structural steel and bar steel were used to a great extent in all the various kinds of construction.

A study of the half-tone, Fig. 1, will show that this rack is constructed almost entirely of structural shapes and flat and round bars. There are four vertical frames, the same as the one shown in the front of the rack, placed equal distances apart, so that the total depth of the rack frame is 16 feet. These vertical frames are fastened together on the sides and top by means of triangular bracing made from heavy flat steel. The base of each frame is a heavy I-beam carried on a wide plate of steel. This plate is used in order to distribute the enormous load over a large enough floor area to get the proper bearing support. The ends of the frames are small channels. The intermediate uprights are flat bars and the horizontals throughout are round bars. Upon some of these horizontal round bars are placed short pieces of standard pipe cut in between the flat verticals and acting as spacers for these verticals. There is sufficient room behind the rack so that bars 20 feet long can be placed in any compartment desired. The width of the rack, looking along the face, is about 16 feet, and the hight 12 feet. The strength is sufficient to support the load in the rack provided every compartment should be filled with bar steel. It will be seen from the half-tone that the rack was very well filled when the photograph was taken.

There are four of these large racks in use, carrying many sizes in rounds, squares and flats, and in many grades of steel, bessemer, open-hearth, tool steel, screw stock, cold rolled, special steel, and so on. In all, there are in storage in the rough-stock department about 2500 tons of steel. The different grades and sizes are carefully sorted and put into individual compartments. They are indicated by different markings on the end of the bar, these markings being put on with colored paint. It might be noted in passing that this rack contains 170 separate compartments, 17 in a horizontal direction, and 10 in a vertical direction, including the top of the rack.

The detailed construction of Fig. 2 needs no explanation. It consists of vertical pieces of extra-heavy pipe carried on an I-beam base; clamped thereto is a series of cast-iron arms divided into sections by means of vertical steel pins. These sections are of about the same size as the sections of the larger rack which has been described and are used for the same purpose and in the same way.

One point of waste where large quantities of steel are handled is in the short ends. If a toolmaker comes to the stock room and wants a short piece of tool steel or of any other kind of steel, it is often much easier for the attendant to cut off a piece from the end of a long bar than to hunt up a short piece which may be of just about the right length and just as serviceable. In the stock room which we are describing this feature is cared for by what is called a short-end rack. This is a rack having a skeleton steel frame similar to the design shown in Fig. 1, but the compartments are lined with sheet steel, so as to make an open-end box. In these

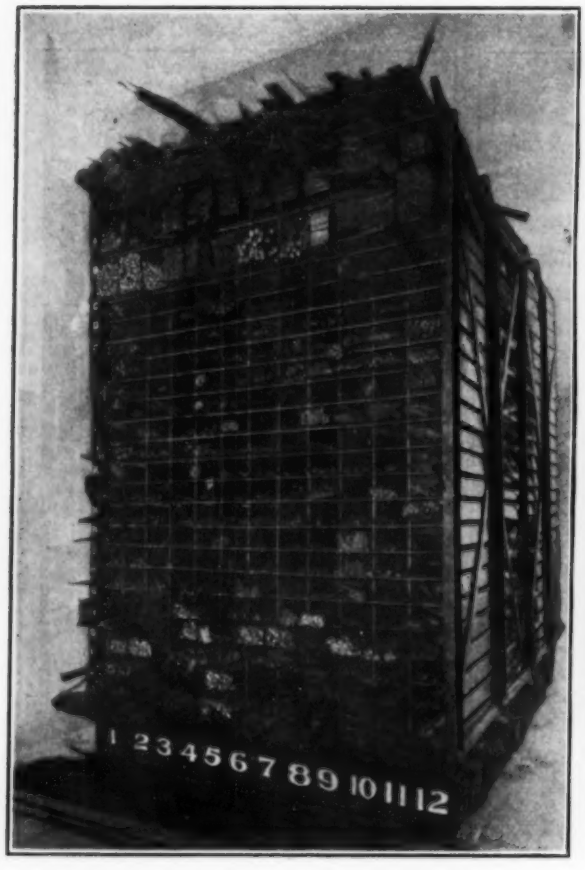


FIG. 3. DRILL-ROD RACK

FIG. 4. SHEET-STEEL RACK

compartments the short ends of the various kinds of steel are properly sorted out and classified, so that if anyone wants a short piece of any grade at any time, it can be taken from this short-end rack instead of cutting a full-length bar. The economies from this method are obvious.

In front of these racks is a set of platform scales for weighing incoming and outgoing material; nearby is the cutting-off department, equipped with cold-saws for cutting bars to required length as the orders may call for. The department is also plentifully supplied with special trucks for transporting the material throughout the department and to whatever places it may be desired.

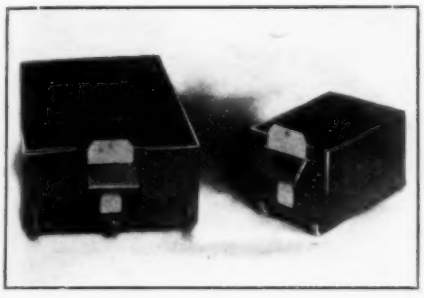


FIG. 5. TOTE BOXES

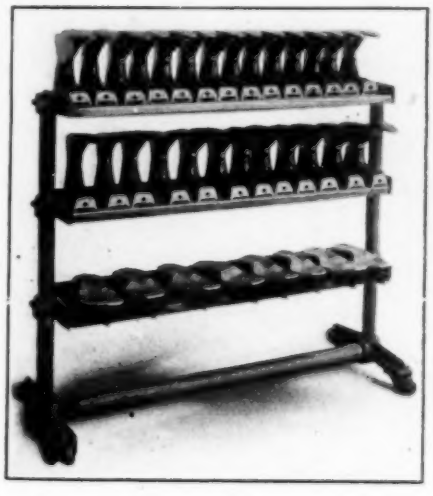


FIG. 6. A PORTABLE RACK

A Rod Rack

Fig. 3 shows a rack used for storing drill rods, bessemer rods and special sections of cold-rolled steel. Its general construction parallels that of the rack in Fig. 1, except that each one of the compartments has a sheet-steel liner. This is of course necessary, because many of the rods are small in diameter and would sag and cause trouble if stored in an open rack. A similar rack is used for storing cold-drawn and cold-rolled steel shafting cut to length, cold-rolled strips and other materials of a similar nature.

A Sheet-steel Rack

Of all the raw materials to be stored, perhaps the most difficult problem was presented by sheet steel. In the average machine shop—and the one which we are describing is no exception—only a limited amount of sheet steel of any one quality and gage is kept on hand. However, there are many different qualities and gages, so that the problem presented itself of storing a large number of different kinds but only a few sheets of each.

The way in which these conditions were met is shown by Fig. 4. A base frame was constructed of channel beams. Running crosswise of this frame were 4-inch channels each of which formed the bottom of two sheet-metal compartments, as the rack was double faced. Pieces of 4-inch extra-heavy wrought-iron pipe ran from this base frame to channel iron frames overhead. To these vertical pipes cast-iron crossheads were securely bolted, as indicated at *A* in the half-tone. The upper channel beam frames were hung by large bolts from these crossheads.

Running between the upper and lower frames were vertical strips of 2x¼-inch flat bessemer. These were spaced 4 inches apart and formed the sides of the various compartments. The locating holes in these strips were punched exactly the same length apart, and when the upper channel beam frame was drawn upward by means of the large bolts passing through the crossheads, these flat verticals were placed in tension, thus making a dividing wall between the various sections which would not buckle easily from the weight of the sheets. It is thought that this construction is novel for its purpose, and its success can be very well judged by a study of the half-tone Fig. 4. In general the separating strips are vertical, although each compartment is well filled with material. The rack contains 120 compartments 4 inches wide, 9 feet high, and about 3 feet 6 inches deep. There is a stop through the center of the rack, so that sheets cannot slip through from one side to the other. Near this rack is located a stripping machine and a shearing machine to cut the sheets into whatever size is desired for subsequent manufacturing operations.

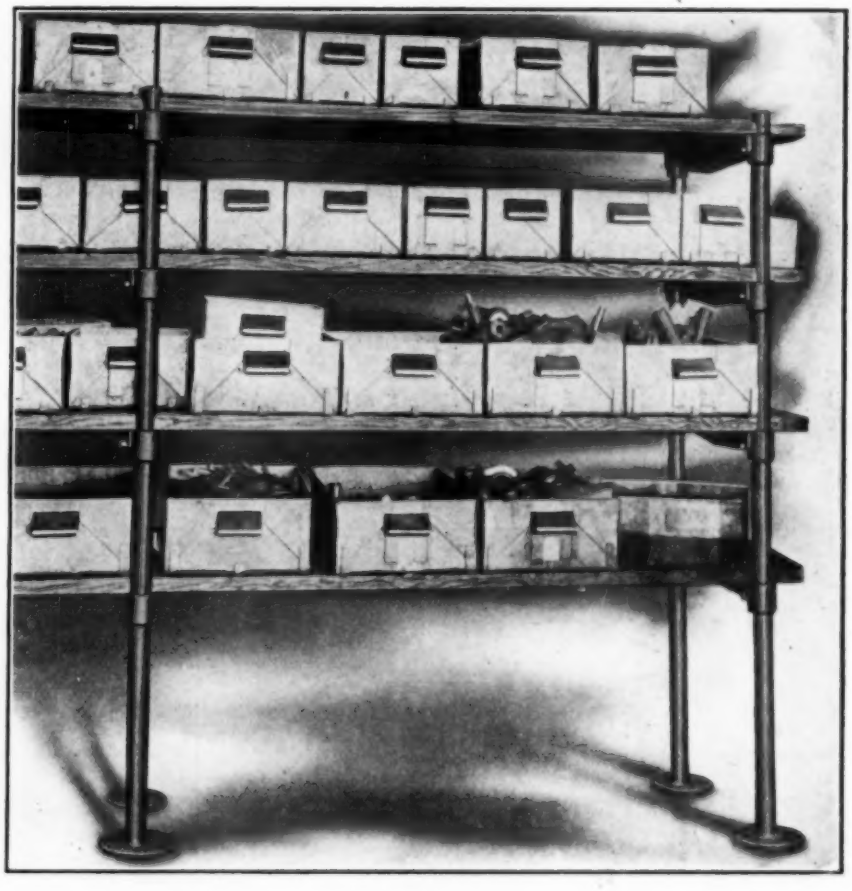


FIG. 7. CLEARING-HOUSE RACK

Wire Racks

Wire in coils is stored for the larger sizes in bins, and for the smaller sizes on shelves. These racks are so general in character that they are not illustrated in this article.

Casting and Forging Racks

The storage of castings and forgings is not entirely worked out as yet, but the general scheme is the same as is used for the finished parts, which of course the castings and forgings parallel in size and

quantity. These methods will not be described at this point, but will be deferred until the question of finished-parts storage is taken up. It should be stated that a debit and credit system of accounts is kept, so that at any time accurate data are at hand for all raw material in storage. As this is similar to the one used for finished-parts storage, it will also be left until that system is described.

Work-in-process Storage

One of the important things in handling work in process is tote boxes. Fig. 5 shows two sizes of the same general design, which were developed and made for the Beverly plant. Of course there are many styles and sizes of tote boxes which could have been purchased in the open markets, but none seemed exactly suited to the requirements. The boxes illustrated are each made from a single sheet of steel, with folded corners, so that the box is oil-tight. It is securely riveted and the folds across the ends add considerably to its strength and rigidity. The larger size has three flat steel shoes to prevent wear of the bottom when the box is dragged across the concrete floors. Similarly the smaller and the intermediate size, which is not shown, have two shoes.

The handle is special, as will be seen from the illustration. This is made from a single piece of sheet steel of heavy gage, rolled and bent to give an easy grip. Its shape is such that the tote hook can be easily caught beneath the handle for dragging it across the floor. Behind the handle and between the handle and the box is a small space in which an information tag can be placed. The handle on the other end of the box is of the same general design, except that this tag space is omitted. The sizes of these three boxes are as follows, beginning with the larger: 20x12x8 inches, 13x10x8 inches and 11x6½x8 inches. The style of handle has proved much more satisfactory than the one usually furnished on commercial boxes. In this same connection large metal boxes on trucks are used for orders where there are a great many pieces, or for pieces which are too large to handle successfully in the boxes. Pulleys are handled on special pulley spindles made with a round base, so that a stack of pulleys can be easily rolled from one position to another.

Many irregular parts, such as complicated and delicate castings, long slender shafts and the like, are provided with special trucks arranged to hold each piece separately and thus avoid injury by springing while being transported around the floors.

List No. ..... Machine .....

Order No. ..... No. Pcs. ..... Date .....

Part Name .....

Received					Passed				
No. Pcs.	By Dept.	Oper.	No. Remain	Date	No. Pcs.	No. Def.	Date	To Stk.	Cont. No.

FIG. 8. STOCK-IN-PROCESS RECORD FORM

FIG. 9

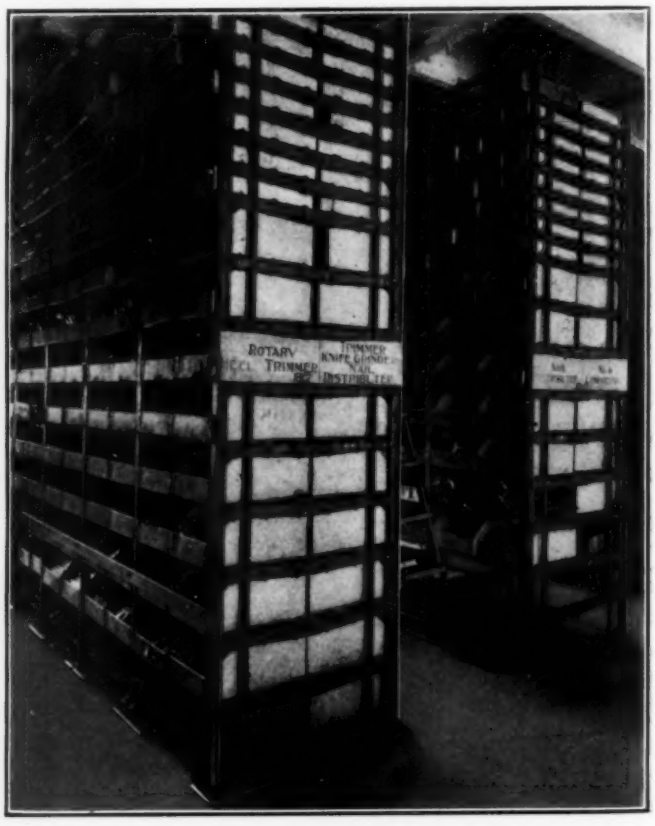


FIG. 10

FINISHED-PARTS RACKS

Such a special metal truck is shown by Fig. 6. The parts are lasts and forms for shoes.

Clearance House

One important feature of the work-in-process storage is the clearance house. This is a department which has direct charge and authority over all work in process which is not actually being worked upon by machine tools. All parts awaiting manufacturing operations are centered and stored in this place. There are detailed records of each and every lot of parts, showing whence it was received, what operation is next to be performed, the number of pieces, order and list numbers, and so on. This department turns over to the manufacturing department such orders as are in a hurry, or which should be worked upon at once for any reason whatever, and thus there is absolute control of the factory production. The smaller parts are carried in tote boxes such as have been described, and these are arranged on racks, as shown by Fig. 7. This rack differs from the others which have been shown in that it is not entirely of metal construction. The shelving is of wood, while the uprights and cross pieces are of metal.

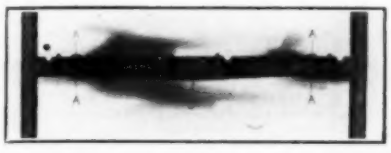


FIG. 11. A UNIT CASTING

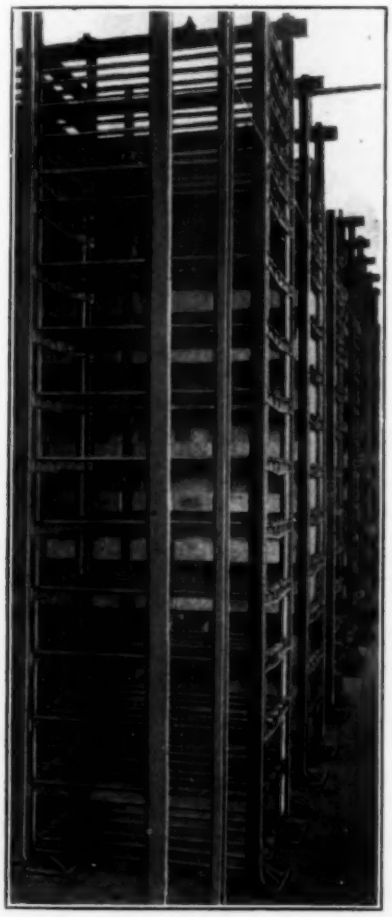


FIG. 12. A RACK FRAME

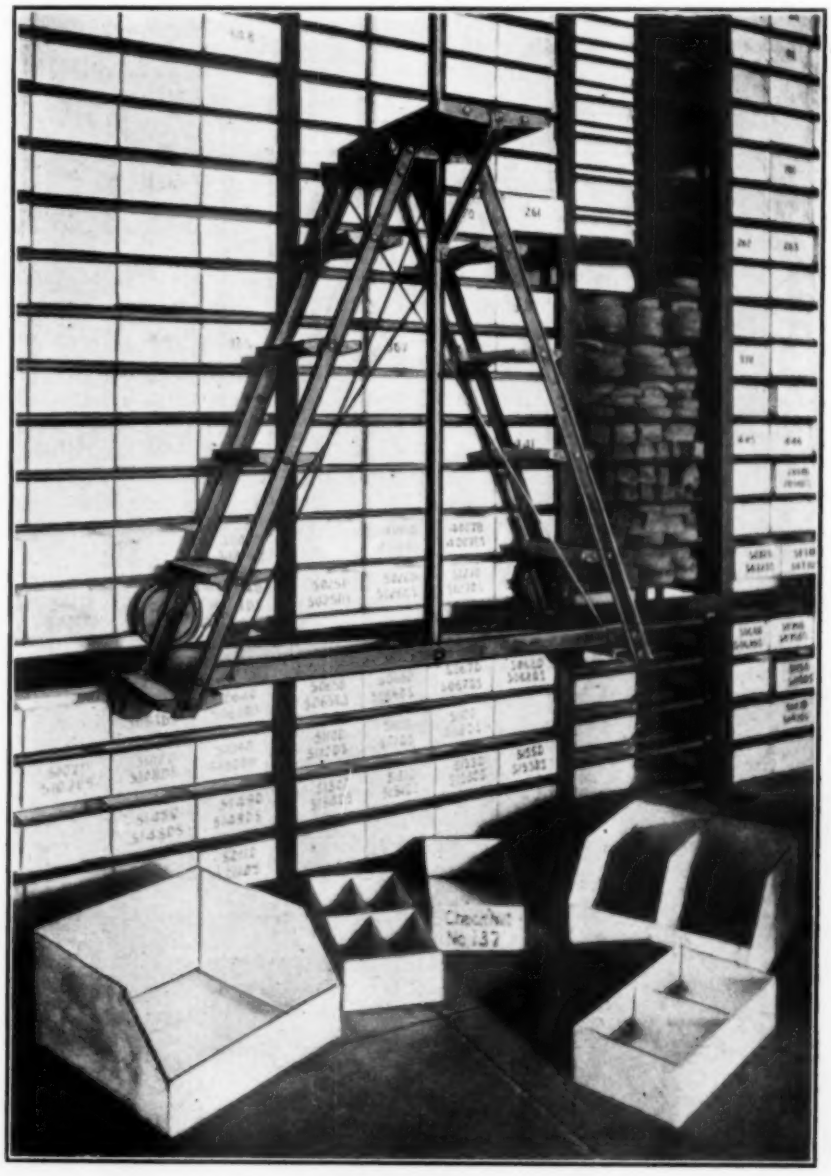


FIG. 13. RACK BOXES AND LADDER

Work-in-process Record

The data of receipts and transfers made by the various clearing houses, which are located at convenient points throughout the plant in connection with the manufacturing departments, are gathered together and tabulated into what is known as the work-in-process record. This is located in the main office and is under the direct charge of the chief inspector. This record shows just what manufacturing orders are issued and the location and condition of the raw material or partly finished parts which apply to that order. It is a most useful and vital part of the factory system for a plant as large as the one which we are describing; for from this record an exact knowledge can be had of all the work which is being manufactured in the entire plant. Fig. 8 shows a form for this record.

This form is made out on a 4x6-inch canary-colored card and both sides are used for records, the general heading, however, appearing only at the top of one side. This general heading has spaces for the list number, machine, order number, number of pieces, date, and the part's name. Below this is a section having the general heading "Received." In this section are made all of the records from the various transfer points of parts as they are received by them. The records consist of the number of pieces, the department's symbol receiving them, the operation, date, and a column for parts which may remain provided an order is broken up for any reason whatever. The section headed "Passed" has a column for the

number of pieces, number which might prove defective, date the number of pieces sent to stock—that is, the finished-stock room—and a place for the contract number, in connection with any piece-work which might have been done on the lot being recorded.

It will be seen that many data can be tabulated on this card, and that by its use any order can be traced from the date it is issued until the date the last piece is turned into stock; the records being in detail for each and every move made by the entire order or portions of the order, provided it is carried through in small lots.

Finished-parts Storage

By far the largest individual problem presented itself in connection with the storage of finished parts awaiting shipment or awaiting orders from the setting-up floor. Its extent has been briefly touched upon in the early part of this article. There were some 70,000 different list numbers, and under each list number there might be from 1 to 100,000 different pieces. These pieces might be small screws or large castings. They were grouped together under about 175 different machine names. It was essential to keep the parts as far as possible in consecutive numerical order, or list-order number, in order to facilitate finding them in the stock room.

The following general principles were laid down to meet the essential conditions of this storage problem: The racks must be made of fire-resisting material; they must be inexpensive, elastic, adaptable, made of materials easily obtained in the open markets and designed on a unit basis. There must be no machine work in their erection; the materials must be capable of being reclaimed should they be abandoned, and the construction must be such that the racks could be easily taken down, removed and set up again with no loss of material.

Any wooden construction was barred by these conditions, as the wood is not fire-resisting; it was expensive with the existing market prices of materials, it could not be reclaimed to any extent provided the racks were abandoned, and did not lend itself readily to a construction which could be removed and easily set up in a new location. An all-metal construction therefore suggested itself and was looked upon as a logical method of development.

An effort was made to find out what others had done along this line. This effort met with failure. It was found that very little had been done in the way of metal racks except ornamental cases, such as were used for library stacks or document files. Nothing was found which

List No. ..... Mach. .....
Part Name .....
..... Consumption for ..... months.

Location { Rack ..... Shelf .....
Price .....

REC'D	DEL'D	FOR	DATE	BAL.	REC'D	DEL'D	FOR	DATE	BAL.

FIG. 14. FINISHED STOCK RECORD FORM

FIG. 15. SETTING-UP ROOM RACKS

would bear upon the problem of machine-shop storage. Only one firm in the United States was found which was willing to give a bid on any kind of metal construction for this purpose. The general size had been determined upon and was 21 feet 6 inches long, 36 inches wide and 12 feet high. This firm made a bid on 70 racks of the general dimensions specified in a construction largely from sheet metal and for a price of $2500 each. As 70 racks were wanted for the original installations, and many more were to follow, this price was clearly prohibitive.

The question of design was taken up by the engineers of the company and their results are shown in the two general views, Figs. 9 and 10. Fig. 9 shows a perspective view of the end of 18 or 20 racks, and Fig. 10 shows a side view and more details. They are of a skeleton steel construction, containing galvanized sheet-steel boxes.

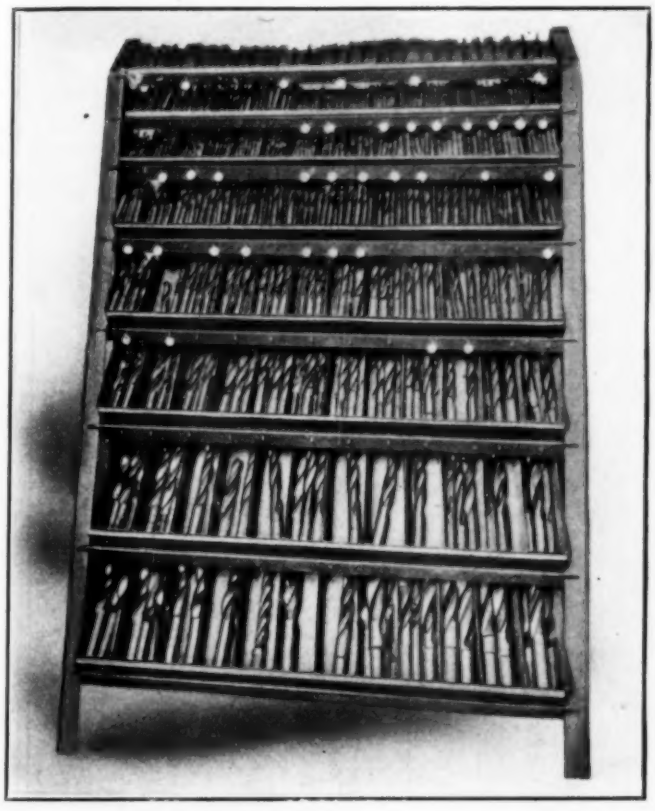


FIG. 16. DRILL RACK

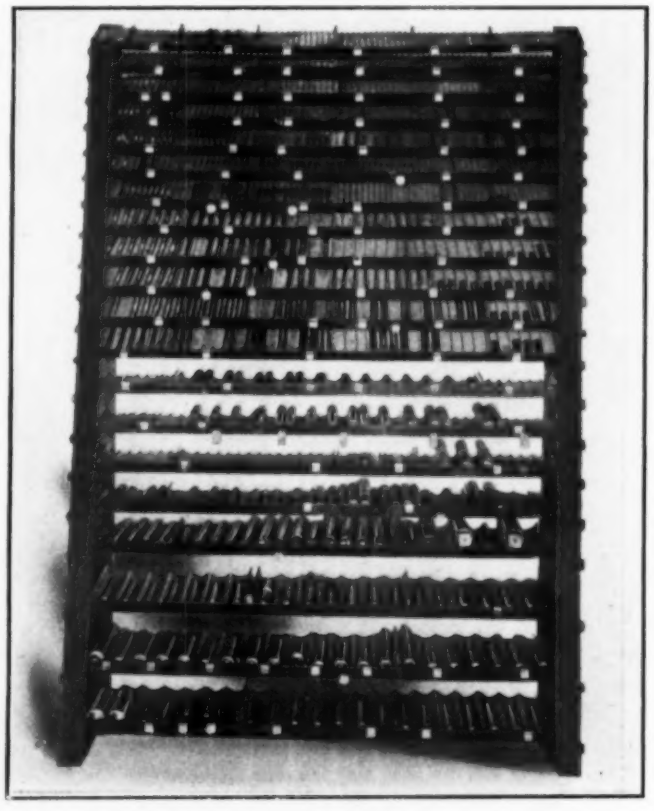


FIG. 17. HAND-REAMER RACK

The Boxes

These boxes are designed on a unit system and are at the basis of the entire storage scheme. The unit was assumed to be a box 9 inches long, 4 inches wide and 4 inches deep. This size was not used as an individual box. The smallest size of box made use of was called the four unit, and is 18 inches long, 8 inches wide and 4 inches deep. It will be seen that its capacity is four times that of the unit. Three other sizes of boxes were used: the eight unit, which is 18x8x8 inches; the double eight, which is 18x17x8 inches, with a center partition dividing it into two sections, and the sixteen unit, measuring 18x17x8 inches.

The dimensions given are approximate. The exact dimensions were made so that boxes of the various sizes could be set into the same space in different multiples, and the dimensions were arranged with due allowance for the proper clearance between the various boxes fitting into a given row. The four-unit box was divided when necessary into two compartments each of which represented a volume equal to two units, or into four compartments each of which represented a volume equal to the unit. The lower part of the half-tone, Fig. 13, shows some of these standard boxes. The smaller sizes were made from No. 20 gage, heavily galvanized sheet steel, and the larger sizes from No. 18 gage. They were fastened together with galvanized rivets; no solder whatever was used. Thus they are not oil-tight. It was anticipated that this feature would present no difficulty in use, and experience has proved that it does not.

The Racks

The framework consisted of a metal skeleton made of small industrial rails, bessemer-steel rods, castings and bolts. One of the so called unit castings is shown by Fig. 11, and the skeleton construction by Fig. 12. The uprights, which are spaced 36 inches on centers each way, are 2-inch industrial steel rails placed with their heads facing in a direction across the rack. Between adjacent rails and clamped to them are unit castings. These castings clamp to the head of the rail. Bosses will be noted at the point *A*. These are of the right size to enter a piece of 1-inch standard wrought-iron pipe. Pieces of second quality, or used wrought-iron pipe, were cut to standard lengths and used as struts or spacers between these castings. On the floor the vertical rail entered a socket in a base plate and a boss on the plate entered the end of the lowest piece of spacing pipe. These struts carry the weight of rack and contents.

Semicircular recesses will be noted in the upper part of this unit casting, and adjacent to each recess is a small projection. Three-quarter-inch hot-rolled bessemer rods were laid across these unit castings for each shelf level. They entered the semicircular recesses and were clamped in position by the head of a carriage bolt, which bears against the rod and the projection. The body of this bolt passed through a cored hole, with the nut on the under side. These clamping bolts held the bars in position and gave rigidity to the racks lengthwise. Thus a rack had a standard width and a standard length of section determined by the spacing of the vertical rails, but the vertical hight of each section could be varied to suit the requirements of the storage by changing the length of the spacing pipes or struts. The rack was divided into a series of skeleton shelves, each shelf formed by six ¾-

inch round bars. On these shelves could be placed boxes, such as have been described, or the parts to be stored, if they were of a size and shape not well adapted to enter a box.

A small recess will be noted in the lower part of the casting marked *D*. The ends of ½-inch rods were placed in these openings or recesses, reaching between the castings. These were in such a position that they acted as a stop for the boxes, so that a box could not be pushed through from one side of the rack to the other. The racks are double faced, 36 inches wide, and the standard length of box is 18 inches; thus boxes are inserted from each side of each rack, and the aisle between serves two adjacent racks. The racks were clamped, not bolted, to the concrete ceiling construction of the room in which they were placed. It was found that they were very stable even when not loaded, and when filled with material they are immovable. It is estimated that a rack completely filled with material has a total weight of about 200,000 pounds. No machine work whatever entered into the construction of these racks. The rails were ordered cut to length from the mills. The shelf rods and the stop rods were similarly ordered to length. The castings were used as they were received from the foundry, and the bolts were ordinary commercial material. They are erected for a small sum, the regular piece-work price being a little less than $10.

As these racks were set up in long parallel rows, as shown by Figs. 9 and 10, and as they are 12 feet in hight, it was necessary to provide a ladder or other device in order to reach the upper part. For this purpose a suspended ladder was developed, shown by the half-tone, Fig. 13. This is carried on the face of one rack on suitable wheels, with a guide wheel overhead, running against one face of a piece of angle iron. It is raised about 2 feet from the floor, and is narrow, occupying only about one-half the width of the aisle. Thus a person can pass the ladder in any aisle, no matter what position it may be in, and there is ample room for a truck loaded with material to pass beneath it. The shelf at the top is convenient for holding pans if material is being removed from, or placed in, boxes in the racks. The ladder is constructed of light rolled sections, castings and, for the main upright, a piece of extra-heavy 2-inch pipe.

About 100 racks of the type and size described have been built, and others are in process of construction. The original order for boxes, which was placed with the J. F. Bingham Company, of Lawrence, Mass., was said to be the largest order of its kind which had ever been placed in this country at that time—the early part of the year 1905. In all, some sixty or seventy thousand boxes have been purchased for this purpose, to say nothing of the many carloads of steel, and perhaps a half million pounds of castings. A consideration of the construction will show that very much of the material could be reclaimed at almost its full value in case

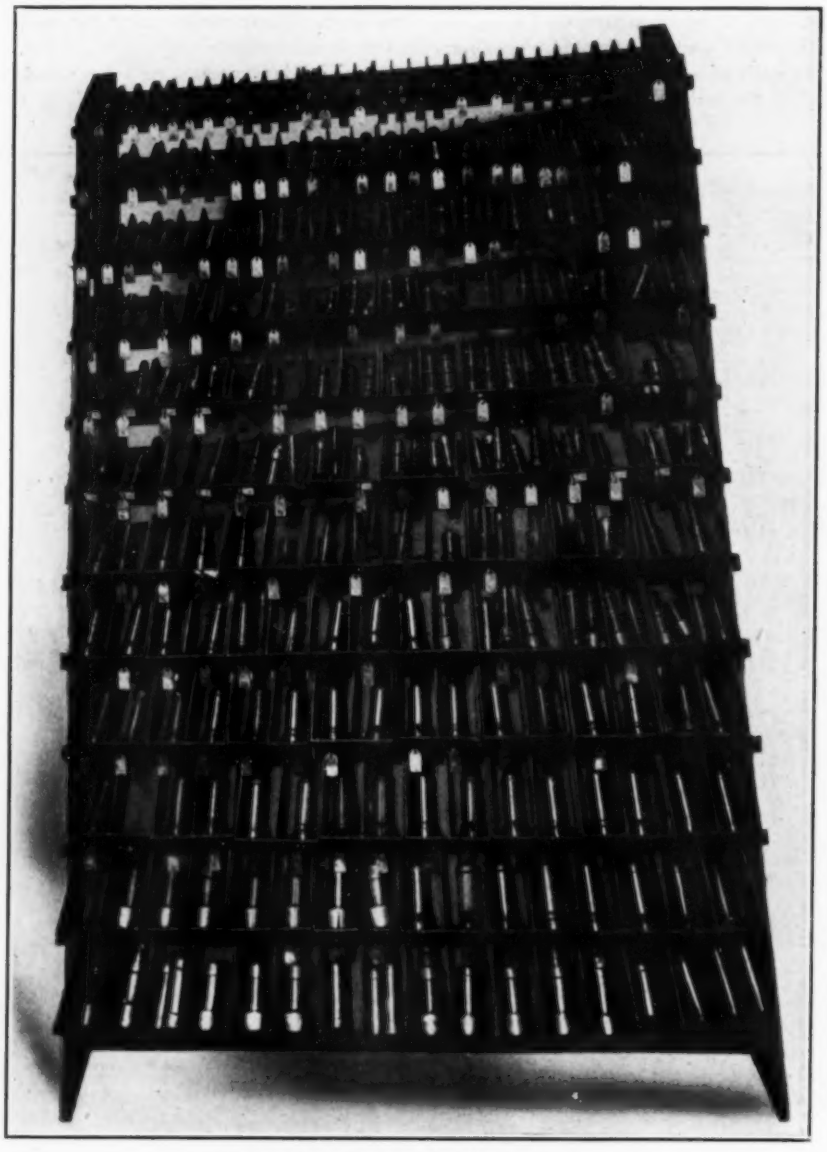


FIG. 18. SCREW-MACHINE TOOL RACK

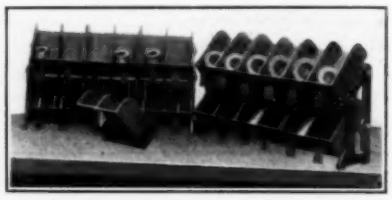


FIG. 19. SMALL-HOOK BOX RACKS

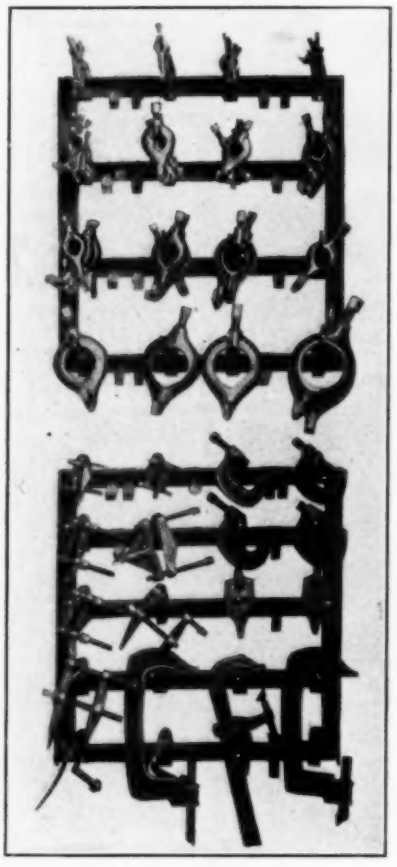


FIG 20. DOG AND CLAMP RACKS

these racks should be abandoned. They are vastly cheaper than the racks which were bid upon when the proposition was first taken up, and in fact I have never seen any racks advertised which equal these in that particular.

Stock-room Records

Fig. 14 shows a form used for the stock-room records. This record is a debit and credit account of all parts entering and leaving the room. The form needs little explanation. It shows at a glance just how many parts are in stock of a given list number, and each entry when parts were received and delivered. To show the degree of accuracy of this record, it should be stated that the yearly inventory is taken directly from these cards without reference to the parts in stock.

Erecting-floor Storage

The method of storing parts on the setting-up floor while awaiting to be assembled into finished machines is shown by Fig. 15. The parts are held by galvanized sheet-steel boxes in portable metal racks. The boxes are of various sizes, while the racks are uniform. The general idea of construction is the same as for the large stock-room racks, except that these are portable. This feature is introduced in order that the racks may be taken to the general spare-parts storage room, filled with parts and then returned to the setting-up floor. It will be noted that the boxes are numbered and lettered, indicating the parts which they contain. A given rack may have any combination of boxes or shelves, suited to the parts of the particular machine for which it is being used.

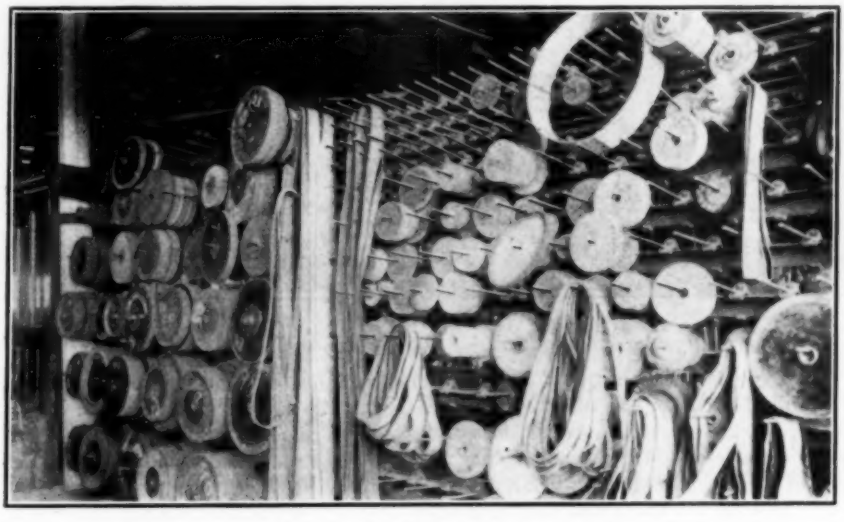


FIG. 21. POLISHING-WHEEL RACK

Tool Storage

We are now to consider a different class of storage; namely, the storage of small tools in the tool-room vaults. This is another point where many machine-shop organizations and systems are weak—in the proper classifying and storage of the small-tool equipment. In most factories, and even in some of the largest in our country, the tool-room devices for arranging and storing the tools are of the crudest, being in general rough shelving and boxes of wood. The introducing of metal storage devices in this place is perhaps more of an innovation than in connection with the storage which has been described. The result has been satisfactory. Many designs had to be worked out to care for the various classes of tools. Not all of them can be described in an article of this character. However, the more general machine-shop small tools will be considered, and the construction of the racks shown is typical for the entire equipment. The element of fire-resisting construction was made prominent here as elsewhere.

A Drill Rack

The half-tone Fig. 16 shows a rack for twist drills. It is composed of an angle-iron frame, carrying for the smaller-sized drills cast-iron boxes divided into small partitions, and for the larger-sized drills sheet-steel boxes. In this way drills of various sizes are separated, kept in well arranged order and are instantly accessible whenever called for at the tool-room window. A hook for the workman's check will be noted in front of each compartment.

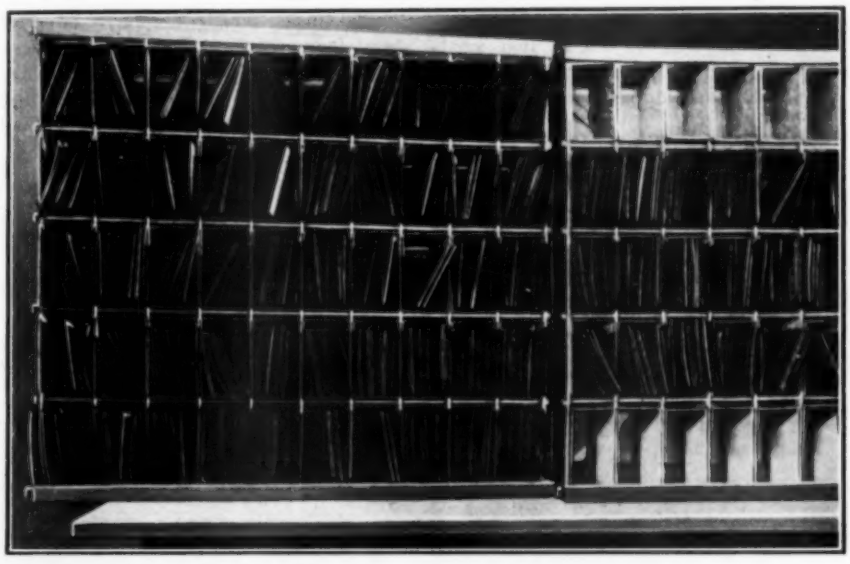


FIG. 22. BLUE-PRINT RACKS

Hand-reamer Rack

The rack illustrated by Fig. 17 is for holding hand reamers. The frame is similar to the one used for the drill racks, but the shelves are different. It was necessary to have the material composing the shelf such that the flutes of the reamers would not be injured while being placed thereon or taken therefrom. Therefore some soft metal had to be used. They were finally constructed of sheet zinc, made into a form which can perhaps be best described as a "washboard." The depressions are of different sizes, adapted to different-sized reamers. Each reamer has its own particular pocket; thus they do not touch one another. In this way, with careful handling by the tool-room attendants, there is very little injury to the tools. This condition is a distinct improvement over the method often used of having many reamers of the same size in one compartment, so that they can touch each other and be knocked about when the drawer or shelf is moved or jarred. As will be noticed, the upper shelves are inclined, while the lower shelves containing the larger reamers are horizontal. As in the case of the drill racks, hooks are provided on the front of each section for the workmen's checks.

A Screw-machine Tool Rack

In Fig. 18 we see a rack styled a hook-box rack and holding chucks and feed

tubes for screw machines. The frame is a skeleton having angle-iron sides and round cross bars. The boxes are made of cast iron and have a hook on the under side at the rear, as shown by the box in the front of the half-tone forming Fig. 19. These boxes are hooked over the horizontal cross bars and form a series of individual pockets, as the illustration shows. This same type is used for large vertical racks placed against the side walls. It is a very elastic construction, as boxes of various sizes can be made and arranged in a manner suited to the tools which they are to hold. Fig. 19 shows two small shelf racks carrying these cast-iron hook boxes and containing plug and ring sizers.

Dog and Clamp Racks

The half-tone Fig. 20 shows two small wall racks carrying dogs and clamps. They need no description.

Polishing-wheel Racks

A polishing-wheel and strap rack is shown by the half-tone Fig. 21. It is an angle-iron frame carrying a large number of pins upon which the wheels and straps are hung. The spacing of the pins can be varied to suit the various diameters of the wheels. The spacing of the cross bars in a vertical direction is of course fixed by the construction.

Blue-print Racks

As this factory uses a system of model drawings instead of samples in its general manufacturing, the question of blue-print storage is a real one. Upward of 35,000 blue prints are in the general circulation files. They are stored in metal racks, which are illustrated by Fig. 22. The racks are made of a galvanized-iron frame and galvanized-iron partitions. The compartments are clearly shown by the rack at the right of the illustration.

While only a portion of the storage devices of this plant has been shown, still enough has been illustrated and described to enable the reader to see the extent to which metal construction has been used for storage devices. Unquestionably devices of this character are coming into more and more favor. There are several firms which regularly advertise metal factory equipment, where there were none in 1904 which could handle a proposition of the size which we have outlined. It is a form of construction which will increase in use, for it has behind it real advantages.

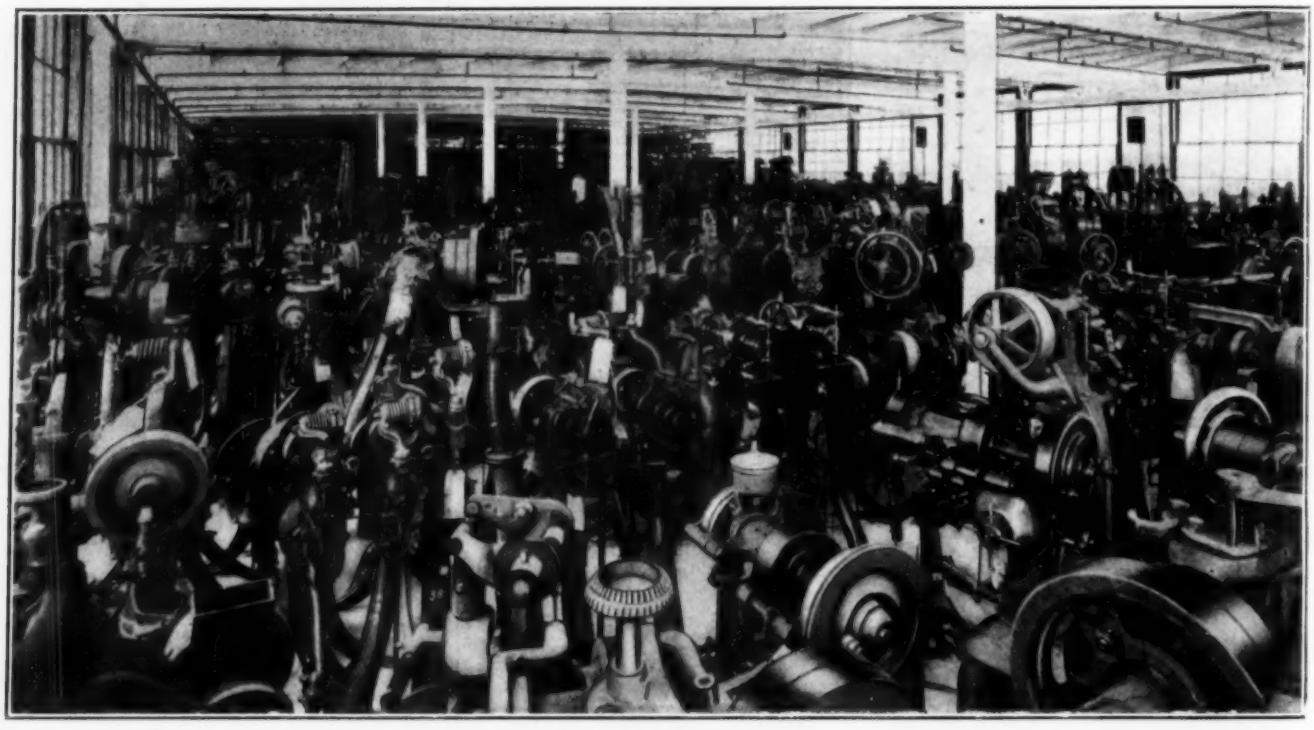


FIG. 23. THE MUSEUM

The Museum

I will touch upon one other element of storage in closing, although this does not show metal racks. On the upper floor of one of the main buildings is a large room 120 feet long, 60 feet wide, and in every way as pleasant as one of the main manufacturing floors. In this large room are stored machines and devices showing the history and growth of the art of boot and shoe machinery. Here, among the hundreds of machines, appliances and devices, can be seen fundamental principles worked out in perhaps a crude form some 10, 25 or even 40 years ago, and alongside a perfected machine of the present time for doing the same work. Some exhibits, could we know their history, would probably tell of unfruitful dreams and efforts. Others are the products of fierce business competition, and still others are the result of months and even years of patient study and work. All kinds of materials, all kinds of motions, are in this collection, for it dates back over a period of 40 years or more in the art of shoe-machinery making.

Different machines illustrate the habit of mind of their inventors. For here side by side are two machines for doing the same work; one is covered profusely with cams, while the other is made entirely of lever and link motions. If we could know the money cost of all this, the sum would undoubtedly startle us. How many other machine industries can show such a collection of history in any one line of manufacture? Of course, one reason for gathering it together and preserving it is the patent situation. Yet the exhibit is of general interest, aside from this important feature, and it is to be hoped that it will be carefully preserved for many years to come. Fig. 23 shows a portion of this large room and some of the machines and devices which it contains.

A novel suit has been brought by Fred Kuhmmel against the Oliver Chilled Plow Works, at South Bend, Ind., in which he asks $5000 damages and a perpetual injunction against the defendant in operating an electric sign 200 feet long on the warehouse of the plant. The plaintiff says the sign, which has over 4000 incandescent lamps and requires 165 horse-power, "turns night into day, produces ill-health and discomfort to himself and family, shakes the house and induces boys and men to congregate about his premises to play ball at night and indulge in revelry." —*Electrical World.*

An Economical and Practical Cost System*

Describing a Simple and Effective Shop Cost System for Machine Builders, the Forms Used, and Its Installation in a Factory

BY B. A. FRANKLIN

In talking about costs to practical men, it has seemed to me that those who make it their business to know the details of cost methods have too often confined themselves to talking general principles, or about certain details, which—no matter how true and scientifically applicable—are not always of much more real use to the practical man than a republican constitution is to the Czar of Russia, or the plant manager's best advice is to the business agent of a labor union.

I frequently find in my experience—too limited, perhaps, let me grant—that there is considerable discussion about certain detailed cost methods to be used, when there does not exist the whole of which the discussed method is a part; just as if there might be a discussion of the relative value of the wire or wooden spokes of the wheel of an automobile, when it lacked an engine. As the machine builder advances the economical value of his machine to the user by an illustrated catalog showing the peculiarly graceful, strong lines, special appliances, and speeds of his machine, but shows its merits with a picture of the whole machine, I am going to show the cost system of a machine builder in actual use today—how it was started, its main principles, its form, its use, its economy, and some of its difficulties in development.

Without attempting, except here and there, to discuss the rightness or reason why certain expenditures are classed in the particular way they are, I assume as axiomatic that modern conditions and success demand cost systems, as surely as rain demands umbrellas. Without pretending that it is the best possible system, or the only right one, let me say that it covers the whole situation, gives the maximum amount of bulk information, and is susceptible of being developed in as much or as little detail as seems desirable.

Situation Covered by Cost System

The cost system shown covers an iron foundry, a wood-working shop, a machine shop and an assembling shop. The plant in which it operates is not a large one, having about 150 employees, and doing a business of about $400,000 a year; and yet it is believed from experience that the system is an elastic one applicable—with changes not radical—to a large plant.

DATE IN-VOICE	VOUCHER No.	NAME	ITEM	DATE PAID	MATERIAL AMOUNT	MATERIAL IRON CAST'GS	MATERIAL IRON & STEEL	MATERIAL LUMBER	MATERIAL BRASS CAST'GS	MATERIAL SUNDRY MATE'L	PROD. LABOR	EXPENSE	MISCEL.	ACCOUNT
	00													
5/10/07	01	Pay-roll		5/10/07	2502.72						2016.09	484.63		N.P. Labor
4/10/07	02	Johnson Fdry. Co.	Iron Castings	"	304.17	304.17								
4/28/07	03	Smith Brass Co.	Brass "	"	208.29				208.29					
"	04	Kilby Lumber Co.	Spruce	"	2300.00			2300.00						
4/19/07	05	Jones Tool Steel Co.		5/11/07	1800.25		300.03					1500.25		Tool Steel
"	06	Jackson Supply Co.	Files	"	18.00							18.00		Files
4/29/07	07	Wilmot Screw Co.	Screws	"	25.00					25.00				
"	08	Samson Machine Co.	Planer	"	2000.00								2000.00	New Machinery
	09													
	Etc	Etc.							Etc.					
	to													
	49													
Total					14872.16	304.17	1000.23	2250.00	208.29	300.00	4020.18	4539.29	2000.00	

Form 1 Voucher Register

Basic Principles

A first advantage is that the clerical force employed in its operation consists of but two men, the bookkeeper and assistant, and these two do all the work illustrated, including the regular duties of bookkeeping, billing, pay-roll, etc., and keep it strictly up to date without overtime work. This is mentioned because the bugaboo of the practical man's consideration of a cost system is the clerical expense attached to it.

A second advantage is that it is a practical man's cost system because it presents the facts in condensed and understandable figures and the details can be had as desired.

A third advantage is that though it took eight months' time to develop into practical and running shape, its present condition and operation are as routine as the operation of the power plant, and it has grown to be just as important.

A fourth advantage is that, being kept through the books, we can and do know that it is right within practical and provable limits.

This system was built on certain definite principles:

The first and most important of these principles was that to get the cost of machines, the practical way was to get the cost of the whole and all machines and develop the part or detail cost as desired or essentially necessary; not to get all the detail costs and throw them together to get the whole cost.

The second principle adopted was that the costs should be gotten up in such a manner as to be provable as correct. This involves getting the cost of everything done in the factory.

The third principle adopted was that the costs of the whole should be presented in a condensed manner to the executives, and always where possible, in comparison with previous similar machines or parts, the detail to be presented on demand only. The detail is gathered and recorded in such a manner that this is not difficult.

Divisions of Cost

The costs and, indeed, all recorded facts in bookkeeping and records are gathered along four main divisions or under four main heads:

1. Material. By material here is meant only that material which becomes a part of the finished machine. All other material not a part of the finished machine is classed as expense.

2. Productive Labor. By productive labor is meant only that part of the pay-roll which pays for work actually spent in shaping the machine to its finished condition.

3. Factory Expense. By factory expense is meant all that money disappearing or leaving no permanent asset in supporting and advancing the career of productive labor in shaping material into the finished product. This expense, as will be seen later, is proportioned to each machine

*A paper read at the Fortress Monroe meeting of the National Association of Machine Tool Builders.

in ratio of expense to productive labor by departments.

4. SELLING EXPENSE. By selling expense is meant all money spent in disposing of the production to buyers, reducing the gross sale price to a net income to the factory. This expense is shown in a per cent. relation to gross sales.

The showing of the cost of a machine gives the material used in desired detail, the productive labor by departments, the factory expense by per cent. additions to the productive labor of each department, and the selling expense by addition of a per cent. of the selling price. These, added together, make the total cost.

DIVISIONS OF EXPENDITURE

Having fixed on these four main elements, we set about gathering them and applying them in a simple, systematic and routine manner.

The first elements attacked were the third and fourth—the factory and selling expense. These elements we decided to gather entirely through the bookkeeping, and to show therein the proper per cent. relation of factory expense to productive labor and of selling expense to sales.

This led to an arrangement of the bookkeeping to fit into the scheme laid out, and it was determined to show these in such detail that the reason and particulars of the per cent. relations should be made plain and of use for critical purposes. Experience has taught us that most concerns think they can do business on smaller per cents. of factory and selling expense than they really do, and more particularly that certain expenses occurring through the judgment of several men —superintendents and foremen—bear a different aspect as to their necessity and volume when shown in a comparative relation to the whole situation.

We decided that we would make the situation more clear, and less liable to mistake, if at the start all moneys spent were divided into classes just as costs were to be divided, namely; material, productive labor, factory expense and selling.

We therefore introduced a form of journal called the Voucher Register.

Form I illustrates this, and the entries made tell their own story. Every cent expended in the business for any purpose whatsoever goes through this book, so that we know that nothing is missing. The Miscellaneous column at the far right is for certain money spent which cannot be considered as immediately chargeable into the four elements named, such as permanent assets, additions to the plant, machinery, etc., or exchange accounts, as note payments, etc.

It will be noticed that we divide the expenditures for material into certain main divisions, as iron castings, iron and steel, lumber, brass castings and sundry materials. This is in order, as shown later, that as the material is used and reported we can keep on the books a dollars and cents perpetual inventory of it in sufficient detail to show value of raw material on hand monthly; and by checking with actual inventory, show where and how much error has been made in reporting material used.

After the material accounts in this voucher register, Form 1, will be noted Productive Labor. The pay-roll is divided into productive and non-productive labor, and the non-productive labor is put under the head of factory expense.

After the productive labor comes Ex-

ITEMS	INVENTORY EXPENSE SUPPLIES	JANUARY 1907		FEBRUARY 1907		ETC.
		ACTUAL	USED	ACTUAL	USED	
GENERAL EXPENSE						
Office						
Executive						
Cost and Bookkeeping						
Other Clerical						
Stationery						
Postage						
Telephone						
Telegraph						
Legal						
Sundries						
Total						
Drafting Room						
Draftsmen						
Supplies						
Total						
Factory						
Executive						
Clerical						
Storeroom						
Cleaning Up						
General Labor						
Inward Cartage and Freight						
Inward Express						
Total						
Shipping						
Labor						
Lumber						
Supplies						
Total						
Tool Room						
Files						
Drills						
Hack Saws						
Emery Wheels						
Taps						
Cutters						
Reamers						
Tool Steel						
Labor Sharpening Tools						
Labor Making Tools						
Total						
Supplies						
Oils						
Electric Lamps						
Sundry Supplies						
Total						
Grand Total General Expense			400.00		344.00	
Monthly Productive Labor			800.00		820.00	
% Expense to Productive Labor			50%		42%	
Average % Expense to Productive Labor					45.8%	
Amount to Department 1	In proportion to productive labor of		200.00		250.00	
" " " 2			100.00		125.00	
" " " 3			100.00		125.00	
POWER						
Labor						
Coal						
Water						
Oils						
Sundry Supplies						
Total Power Cost			300.00		325.00	
Share to Department 1	Divided in proportion to use		50.00		54.16	
" " " 2			150.00		162.50	
" " " 3			100.00		108.34	
Depreciation						
Taxes						
Insurance						
Total						
Share to Department 1	Divided in proportion to value of investment in department		300.00		300.00	
" " " 2			400.00		400.00	
" " " 3			300.00		300.00	

Form II. Expense Analysis.

pense. All items whatsoever of expense are placed in this column; and in the final column, called Account, is placed the name of the expense. Once a month, as will be seen, the footings of these columns prove with the total of money spent, and one posting a month gives all the information it is designed to gather on these points.

Once a month this expense is analyzed and shown on Form II, Expense Analysis.

Expense Analysis

The expense analysis is the practical man's detailed view of two elements of the four factors of cost, namely, factory expense, its per cent. relation to productive labor, and selling expense and its per cent. relation to sales. Each month's per cent. of factory expense and selling expense is shown as a separate unit; but since the per cent. used in a practical cost cannot be one varying constantly, we run in all cases the "period per cent." or the average per cent. of the months to date.

This period per cent. after some months settles down—except in cases of violent change of condition—to a definite level and is the per cent. used for cost figuring. If the per cent. in the average does vary violently, I think it not unfair to say that something may be wrong in the conduct of the business, and the increase or decrease of this period per cent. is a very good guide point toward advantageous or deleterious conduct. These per cent. relations are definite and easy means of adding these elements of cost to any order, machine or part; the analysis gives a quick, detailed and comparative knowledge of why this per cent. varies, why it is so large, and very quickly, as time progresses, places the trouble.

It is a fact of many businesses that great attention is paid to material costs, that labor costs are carefully watched, but expense is not so carefully watched; because each expense in itself—and at its time of expenditure—bears the stamp of judgment of someone (too often Tom, Dick or Harry) and seems a proper or possible allowance but does not show in relation to the whole which it should do. This expense analysis, very readily and quickly gotten once a month, also shows definitely the cost of certain departments of expense, as designing, office, tool room, etc., and almost always leads to reductions.

The variation of per cent. shows also in one figure the progress of costs up or down; for instance, in times of slack production, it is known—but not often reckoned with—that the per cent. of expense goes up. This method shows why, and offers the detail for criticism and reduction. It is not too much to say that the expense is more frequently a larger element of cost than productive labor in the machine-building business, yet productive labor gets large consideration and expense a smaller one. I have often heard the complaint that a given per cent. of expense was too large, or inaccurate, or not truly representative. This method proves the per cent. shown to be correct whether satisfactory or not as to size.

In this expense analysis, most of the items are the result of direct expenditure and bear little chance for criticism as to their proper placement under the head of expense. The items most disputed about were non-productive labor and depreciation. In the matter of depreciation there have been conceived many and detailed plans for the proper addition of this just charge as a cost item. At best the figure assumed is a guess; but the guess is based on a desire to charge off a sufficient sum yearly to balance, in the long run, that sum of money necessary to be expended to keep an up-to-date plant by proper replacement or changes. In this case about 5 per cent. of the total investment was taken as being safely above that need in the plant, and one that the business would permit.

No other assumed charges were put to expense; all such items as interest on investment, etc., were considered as cared for in the per cent. of profit added in making up the selling price.

In the matter of non-productive labor, every labor item that could not be fairly and justly distributed against an order number was called non-productive, and put into expense, and thus equally divided over all orders. This non-productive labor was shown in considerable subdivision.

It will be noted that there are for each month two columns in the expense analysis. One column represents the actual expenditure; the other represents the amount chargeable to the particular month. For example, taxes and insurance are paid generally once a year; to get a fair monthly per cent., they are pro-rated 1/12 to each month in the year. Supplies may be bought in such quantity as will last several months. When they are reported as used, the used amount can be set down as a charge against the month in which they are used. A little thought will show that this method permits a dollars and cents perpetual inventory if the amount on hand at the beginning is set down.

In the plant in which this system is in operation, this expense analysis brought forth several decided economies as well as

Department _____ Week Ending _____

NAME	NO.	RATE	TOTAL HRS.	TOTAL DAY WORK	TOTAL PIECE WORK	TOTAL PAY	NON PROD. LABOR		ORDER 7216		ORDER 7320		ORDER 7115		ETC.
							HRS.	AMOUNT	HRS.	AMOUNT	HRS.	AMOUNT	HRS.	AMOUNT	
John Jones	28	$25.00 Wk.		25.00		25.00		25.00							
B. Smith	29	25 ¢	58	14.50		14.50				7.50		7.00			
T. Jackson	30	30 ¢	62	17.40		17.40				5.40					
S. Samson	31	20 ¢	58		15.72	15.72			30	7.50		6.00		6.00	
P. Brown	32	15 ¢	58		8.70	8.70		8.70					32	8.22	
Etc.			Etc.					Etc.					Etc.		
Total				279.36	72.89			62.50		28.10		25.00		14.22	Etc.
Expense 120%										33.79		30.00		17.06	Etc.

Form III. Pay-roll Book

		C REPAIR	CLASS C	B REPAIR	CLASS B	A REPAIR	CLASS A	MISCEL.	DATE	ITEM	ORDER NO.	MISCEL.	IRON CAST'GS	IRON & STEEL	LUMBER	BRASS CAST'GS	SUNDRY MAT'L		
							15.00			Iron Castings 500 Lb.	7125		15.00						
				6.60						Brass Castings 20 Lb.	7187					6.60			
										100 Bolts ⅝ x 2½	7289						7.00		
						1.00				200 Ft. Sprue	7016				4.00				
					Etc.		4.00						Etc.						
		20.00		17.66	16.05	4.17	25.25			Total			22.10	7.18	17.00	26.12	10.10		

Form IV Material Journal

elucidating the expense situation. It compelled a thorough reorganization of the tool-room system, since it showed that an unexpected amount of small tools was being bought. It made a considerable reduction in non-productive labor. It brought out the fact that much useless overtime was being paid for. It brought about a changed and more economical purchase and distribution of supplies.

Productive Labor

Having settled the method of two elements of cost, i.e., factory expense and selling expense—the third and fourth items—we next proceeded to the second element, productive labor. Here, by use of a time-note system, which need not be gone into at this time, we turned the pay-roll by means of Form III into a means of gathering and proving the productive-labor costs.

This method may seem complicated where there are many orders. In this plant, where there was an average of 100 different orders per week in each department, it proved simple and economical. It also offers many advantages:

1. It proves the labor charges, non-productive and productive, to equal the total pay-roll, and nothing can be skipped.

2. It permits gathering the total labor on an order very readily, since we merely take the footings of the columns.

3. It shows a picture of the department labor, and permits a quick reference to the detail of any labor at any time without wading through a lot of time notes, which may have gotten misplaced before the information was desired, as in the case of non-productive labor showing too large on expense analysis—which might demand investigation.

4. It also offers a means of adding to each order its per cent. of expense in each department in a simple and sure way.

In fact, it is as complete and concise as the facts can be shown.

Material Used

Having gathered productive labor, factory expense, and selling expense, we come finally to the first item—record of use of material. This is accomplished by means of Form IV. This material is gathered through storeroom and foremen's reports.

Description ___ Machine A1

DATE	IRON CASTINGS	IRON AND STEEL	LUMBER	BRASS CASTINGS	SUNDRY MATERIAL	PROD. LABOR	FACTORY EXPENSE	SELLING EXPENSE	TOTAL COST	SOLD FOR	REMARKS
2/10/07	75.27	14.00	20.00	3.00	10.25	30.25	36.30	13.75	200.82	275.00	
3/28/07	74.05	13.75	20.00	3.00	9.59	40.95	49.14	13.75	225.17	275.00	Hard Iron

Form VI. Manager's Order Cost Book

	DR.	CR.
QUICK ASSETS		
Cash		
Petty Cash		
Bills Receivable		
Accounts Receivable		
MATERIAL ON HAND		
Sundry Stock		
Brass Castings		
Lumber		
Iron and Steel		
Iron Castings		
PERMANENT INVESTMENT		
Real Estate		
Machinery		
COST UNFINISHED CONTRACTS		
Class "A"		
" "B"		
" "C"		
" "D"		
" "E"		
" "F"		
GENERAL PROFIT AND LOSS		
General Expense Undivided		
Interest and Discount		
Income on Investments		
Class "A"		
" "B"		
" "C"		
" "D"		
" "E"		
" "F"		
Profit and Loss		
FOUNDRY PROFIT AND LOSS		
Sales		
Metal		
Productive Labor		
Expense Used		
Expense Undivided		
LIABILITIES		
Capital Stock		
Surplus		
QUICK LIABILITIES		
Accounts Payable		
Bills Payable		

Form VII. Monthly Statement

You will notice that in this form, as well as in all the forms, there is nothing complicated or complex to understand. We do in form and figures exactly what takes place in fact. We establish certain definite material accounts, and as in fact there are taken from the piles of material certain amounts which go to make a certain class of machinery, so we credit on the books the particular class of material with so much money and charge it to the class of machinery. So, at any time—but particularly at the end of the month—we have our totals of credits to material and charges to machinery to use in the books and the detail to put to the order cost.

This offers us a ready means to check the use of material, since beginning with an inventory of raw material and adding constantly the purchases and deducting the use, we have a figure showing what material should be on hand. An actual inventory shows the degree of accuracy and error.

Order Cost

Having thus established regular methods of gathering and recording material, productive labor, factory expense and selling expense, we now come to the final assembling of these facts. This leads, of course, to the establishment of a proper order system, and this order system was established on two principles:

1. An order for all work done for sales purpose.

2. An issuance of orders in such manner as to give the desired or useful information.

The final cost of the order, compiled from the recorded facts, is shown in detail on Form V, and in a condensed way in a small book, Form VI. They tell their own story. The condensed form is for the manager, who did not want to be digging through the detail, but asked for it when he wanted it, and who did want to know the fluctuations of cost.

Form VII shows how all this information is gathered together into the final accounts, which are cast up each month, giving the true situation. It may be well to note that these accounts show the complete situation.

1. The quick assets, i.e., cash on hand and accounts receivable.

Description -- Repair 14" Lathe — Order No. 7125

DATE	ITEM	FOLIO	IRON CASTINGS	IRON AND STEEL	LUMBER	BRASS CASTINGS	SUNDRY MATERIAL	PROD. LABOR	FACT'Y EXPENSE	SELL'G EXPENSE	TOTAL COST	DATE	ITEM	SELLING PRICE
4/2/07	Iron Casting 202 lb.		6.06											
4/3/07	Brass Bushing 10 lb.					3.00						4/4/07		20.00
"								2.75	3.30					
										1.00				
			6.06			3.00		2.75	3.30	1.00	16.11			20.00

Form V Order Cost

16.11
19.9% Profit 3.89

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Week
MELTING							
Pig No.1							
Pig No.2							
Pig No.3							
Pig No.4							
Bought Scrap							
Coke							
Coal							
Limestone							
Cupola Supplies							
Labor							
Total Metal Cost							2016.00
Lb. Good Castings Produced							180,000
Cost per Lb.							.0012
Period Cost per Lb.							.001
MOLDING							
Molding Production							
Coremaking Production							
Helping							
Flask Fitting Labor							
Flask Fitting Material							
General Labor							
Sand							
Coal							
Sea Coal							
Miscel. Supplies							
Total Molding Cost							1350.00
Lb. Good Castings Produced							180,000
Cost per Lb.							.0075
Period Cost per Lb.							.0073
Total Molding Prod. Labor							
Total Molding Expense							
% Expense to Prod. Labor							85%
Period % Expense to Prod. Labor							80%
CLEANING							
Labor							
Supplies							
Total Cleaning Cost							450.00
Lb. Good Castings Produced							180,000
Cost per Lb.							.0015
Period Cost per Lb.							.0016
GENERAL EXPENSE							
Executive							
Power							
Depreciation							
Taxes							
Insurance							
Freight and Express							
General Labor							
General Supplies							
Total Expense							720.00
Lb. Good Castings Produced							180,000
Cost per Lb. Expense							.0040
Period Cost per Lb. Expense							.0039
HISTORY							
Total Lb. Melted							240,000
Lb. Scrap Used							120,000
% Scrap Used							50%
Lb. Good Castings Produced							180,000
% Good Castings to Total Melt							75%
Period % Good Castings to Total Melt							73%
Lb. Bad Castings							5,000
% Bad Castings							2.8%
Period % Bad Castings							3%
Lb. Spruce							
Lb. Floor Scrap							
Lb. Loss							
% Loss							4%
Period % Loss							3.8%
Lb. Coke Used							
Lb. Metal Melted to Coke Used							8.1

Form VIII. Foundry Daily Cost and History

2. The value of raw material on hand. These figures give the proof of the whole cost system. We know the expense is accurate because we get it through the bookkeeping. We know the labor is accurate because we prove it with the pay-roll. In the material cost we depend for accuracy upon the correctness of storeroom reports, and foremen's reports where the material is not kept in the storeroom. But by deducting the monthly report of material used, we arrive at these accounts showing material we should have on hand, and an occasional inventory shows us how accurate the reports are.

3. The monthly profit on each line of machinery.

4. The cost of orders in process by the lines of machinery.

5. The foundry profit or loss. In this concern the foundry is operated as a separate plant, selling its product to the machine business at a slight advance over cost.

6. The liabilities.

So the situation is shown completely every month, just as if stock were taken; and the only chance for error lies in the material-on-hand accounts, which are checked occasionally by actual inventory.

In my experience such a condenesed and complete showing is seldom made on the books of any manufacturing company. It has proved satisfactory, and with ordinary attention it is difficult for this company to be going backward without getting a quick and sure intimation of it, even apart from the order-cost information. The information for these accounts is all gathered from the cost system.

Foundry Costs

Since the foundry is so frequently a part of the machine builder's plant, as it was in this case, we shall say a few words about the method of its cost keeping. Form VIII illustrates it. It is a daily cost and history. In these terms a literal meaning is to be taken. It is the daily dollars and cents cost, and the facts presented show on the vital points, as production, etc., the history of the day's proceedings.

As will be seen, the costs are divided into the operations of metal cost, molding cost, cleaning cost and general expense, and are so arranged that by getting the exact molding labor cost of any particular casting, and, if desired, the exact cleaning-labor cost, the cost of any one casting can be obtained very readily, as per Form IX.

The practical man will recognize that we have shown the costs in the order of practical shop procedure, and that this method of cost, which requires very little time daily to keep up, shows comparatively, day after day, week after week, and in average figures, the cost of castings.

The value of this cost method is its simplicity and its comparative showing, which invariably brings out many weak points, and shows whether they are cor-

Correction see p 421

rected and the value of their correction. It gives quick warning of any retrogression, falling off in production and increase or decrease of any detail of cost. There are very simple methods of proving its accuracy. It never fails to make economies, and becomes eventually—as indeed any quick and simple cost system does—indispensable.

When all is said and done about a cost system, it should give the answer to the questions: What are the results? What has this method accomplished?

It has accomplished, first, an increase of profit due to the fact that the company found itself on some of its work very much in the same position as the druggist from whom an Irishman wanted a bottle. "How much is it?" said Pat. "Empty, two cents," said the druggist; "if I put anything in it, it won't cost you anything." "Then put a cork in it," said Pat. It has brought a right profit on all articles and it was discovered that many articles did not bear such.

The expense analysis alone has saved much money by showing excessive costs in

Patt. No. _____ Order No. _____ Weight 100 Lb.

		COST PER LB.	
Metal Cost		0.0112	
Molding Labor	50%	0.0050	
% Expense Added	80%	0.0040	
Cleaning Cost		0.0015	
Expense Cost		0.0040	
		0.0257	

Form IX Casting Cost Card

several places, notably in tool room and non-productive labor, as previously stated. The comparative order costs have shown, by connection with the foremen of departments, where economy of labor and material could be made, and much reduction of machine cost has resulted. These economies, though quickly spoken of, came gradually, but were permanent and have meant literally thousands of dollars saved and made. This has all been accomplished with the aid of a bookkeeper and his assistant.

It must not be supposed that all this was readily obtained. It was gotten by development during a period of eight months and with no increase in clerical labor. It took perseverance and effort to get labor and material reported right and to get the work finished in routine and close-to-date manner. Many points arose whereby we had to change plans and methods to meet the shop conditions and to arrange the work simply so as not to take more clerical labor.

The New York Elevated Railroad cost $500,000 per mile.

A mixture of boracic acid and common salt is said to give good results as a flux in brazing cast-iron and other metals. It is superior to boracic acid alone as it flows better.—*The Brass World.*

Calculations Respecting Epicyclic Wheel Trains

By W. Owen

It has always been a source of wonder to many of us who are interested in this subject, as to why the treatment of epicyclic gearing is relegated to such a minor position in most of the well-known text books on engineering.

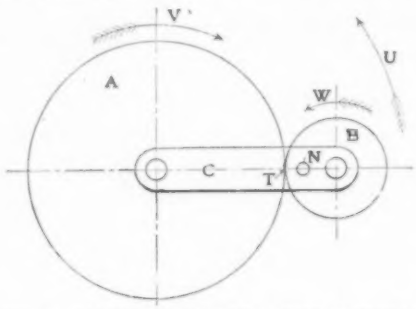


FIG. 1. CALCULATIONS RESPECTING EPICYCLIC WHEEL TRAINS

It is difficult to conceive of a subject at once more interesting and instructive, and last, but not least, more mechanically useful. Mr. Bostock's article, therefore, to use a hackneyed phrase, satisfies a long-felt want, and will be of value to all who have these mechanisms to deal with, and also to students and others seeking information on the subject.

I should like, however, to suggest that Mr. Bostock has not quite attained that desirable ideal of reducing the subject to its smallest dimensions. He has not so treated the matter that it may be condensed into one small, compact and universally applicable rule. This deficiency, if I may be permitted to term it so, I shall attempt to supply, but, in order that this treatment may be thorough and concise I will begin at the beginning. Note the illustrations, Figs. 1 to 3 inclusive.

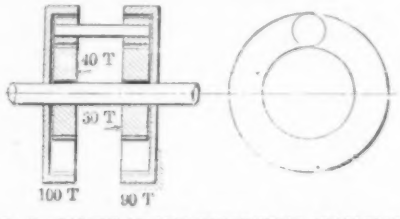


FIG. 2. CALCULATIONS RESPECTING EPICYCLIC WHEEL TRAINS

Referring to Fig. 1: A is a spur gear of 60 teeth, B is a spur pinion meshing with A, and having 20 teeth; C is an arm which is free to revolve. In one end is mounted a stud carrying B. We will determine at the outset that the direction of rotation of the arm, when given, is always designated +; the required direction of rotation of the gears in the same or opposite direction to that of the arm is given by the sign + or —, as the case may be.

Now suppose that the wheel B is locked to the arm by the pin N, so that it cannot rotate on its own axis, and suppose the arm C to make one revolution in the direction of the arrow U. It will be seen that B will carry A around with it; the point of contact T of the two wheels not being disturbed. Thus each member of the mechanism makes one revolution in the direction of the arrow U. Now hold the arm still and take out the pin N; turn the wheel A back again into its original position, that is, give it one revolution in the direction of the arrow V. This movement, of course, will give $\frac{60}{20}$ or 3 revolutions to the wheel B in the direction of the arrow W.

It will be seen that the arrows U and W are in the same direction; therefore the wheel B has made $1 + 3 = 4$ revolutions in the direction of arrow U, or in the same direction as the arm. Thus we see that with the wheel A stationary, and the arm revolving, the wheel B is subject to two distinct motions, one by reason of its connection with the arm, and one by reason of its gearing with the wheel A, and that for each revolution of the arm, B will make 4 revolutions in the same direction as the arm.

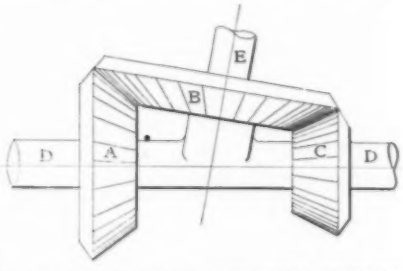


FIG. 3. CALCULATIONS RESPECTING EPICYCLIC WHEEL TRAINS

Let n represent revolutions of the last wheel B,

Let a represent revolutions of the first wheel A

And let l represent revolutions of the arm C.

From the example illustrated, the revolutions of wheel B relatively to the arm $C = 4 - 1 = 3$, or stated generally $= n - l$, and the revolutions of the wheel A relatively to the arm $= 0 - 1, = -1$, or stated generally $= a - l$. Thus

$$\frac{\text{Revolutions of } B \text{ relatively to the arm}}{\text{Revolutions of } A \text{ relatively to the arm}} = \frac{n - l}{a - l}.$$

This quantity is the velocity ratio of the train. Therefore, in this case

$$\frac{A}{B} = \frac{n - l}{a - l} = \frac{4 - 1}{0 - 1},$$

$$\text{or } \frac{A}{B} = \frac{3}{-1}.$$

This brings us to the rule that when the arm is held and the first wheel revolved, if the direction of rotation of the last wheel is the same as that of the first wheel, the quantity for the value of the

train, or $\frac{A}{B}$, must be prefixed by the sign +; if the direction is opposite to that of the first wheel, the quantity $\frac{A}{B}$ must be prefixed by the — sign. The whole crux of the subject then is embodied in the simple rule $\frac{n-l}{a-l}$ = the ± velocity ratio of the train. The sign for the value of the train is obtained by inspection.

This rule is applicable both to spur- and bevel-geared epicyclics, and perhaps one or two examples will be sufficient to show the method of application.

Referring to Fig. 1, calculate the revolutions of B when the arm C makes 10 revolutions, and the wheel A 3 revolutions in the same direction as the arm, stating the rule $\frac{n-l}{a-l} = -\frac{A}{B}$. If the arm be held, and the first wheel A rotated, B will rotate in the opposite direction; therefore the equation becomes:

$$\frac{n-l}{a-l} = -\frac{A}{B}.$$

Solving we get $\frac{n-10}{3-10} = -\frac{3}{1}$, and $n = 31$. Therefore the wheel B makes 31 revolutions in the same direction as the arm.

The application of this method to the somewhat complex train given by Mr. Bostock simplifies the matter considerably.

Referring to Fig. 2, and dealing with the right-hand set of gears first, we require to find the revolutions of the arm due to one revolution of the 30-toothed wheel, when the 90-toothed wheel is stationary.

As before

$$\frac{n-l}{a-l} = V.$$

Inspection of this gearing shows that V must be prefixed by the — sign.

$$\frac{0-l}{1-l} = -\frac{1}{3},\ 1-l = 3l,\ 1 = 4l;$$

$$\therefore\ l = \tfrac{1}{4}.$$

Thus the arm revolves one-fourth of a revolution for one revolution of the 30-toothed wheel, and in the same direction, the 90-toothed wheel remaining stationary.

Referring now to the left-hand set of gears, we require to obtain the revolutions of the 100-toothed wheel due to one revolution of the 40-toothed wheel and ¼ revolution, in the same direction, of the arm

$$\frac{n-l}{a-l} = V.\quad \frac{n-\frac{1}{4}}{1-\frac{1}{4}} = -\frac{1}{2.5},$$

$$n = -\tfrac{1}{10}.$$

Therefore for one revolution of the shaft to which the two wheels, 40-toothed and 30-toothed, are fixed, the last wheel, 100-toothed, will revolve $\frac{1}{10}$ of a revolution in the opposite direction to that of the shaft.

To illustrate the application of the rule to a bevel-geared epicyclic, I give an example which was brought to me for solution some weeks ago. Referring to Fig. 3:

A is a wheel with 40 teeth, and revolves loosely on D. B also has 40 teeth, and revolves loosely on E. C has 20 teeth and also revolves loosely on D. D and E are in one piece.

If D and E make 60 revolutions per minute, and A makes 30 revolutions per minute in the opposite direction, find the resulting number of revolutions and direction of motion of C.

$$\frac{n-l}{a-l} = V = \frac{n-60}{-30-60} = -\frac{2}{1};$$

$$n = 240.$$

Therefore C makes 240 revolutions in the same direction as the arm E. It will be noticed in this example that the first wheel revolves in the opposite direction to the arm, thus a is tabulated — 30.

Care must be taken in stating the value of the train by keeping in mind that a refers to the first wheel, whose number of teeth must appear in the dividend of the value of the train, and n *vice versa*.

W——, England.

Now it is from Spain that the steam engine is to be revolutionized. Consul-General Ridgely, of Barcelona, announces that a Spanish engineer has invented a steam engine which is to cause the revolution that has been predicted so often and so long. Among other things it is to burn but one fifth of the coal and to occupy but one-fifth the space required by the ordinary marine engine. Curiously, however, while this applies also to bunker space, it does not apply to the boilers, which, we are told, "are of the usual dimensions."

Finishing Crank-pins and Piston Rods

By I. B. Rich

The use of rollers for finishing piston rods, crank-pins and axles is not new in railway shops, having been used for a number of years in some localities, and not at all in others. Among the pioneers in this line was A. G. Elvin, formerly general foreman at the Huntington, W. Va., shops of the Chesapeake & Ohio Railroad, who began using the system about ten years ago. As unusual methods of this kind are sometimes short-lived it is interesting to note that the plan is still used in the Huntington shops.

The present master mechanic, C. H. Terrel, sends the details of the tools they are now using which are given herewith. Fig. 1 is the tool for rolling crank-pins,

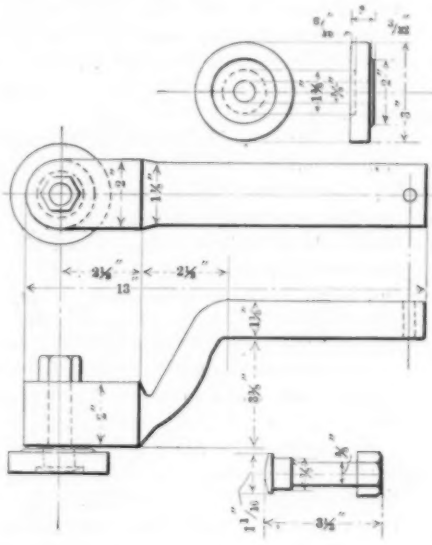


FIG. 1

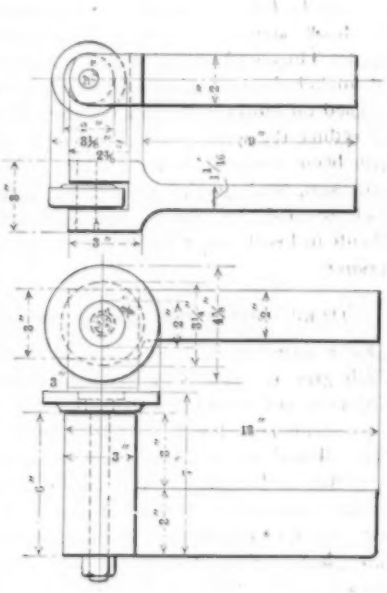


FIG. 2

TOOLS FOR FINISHING CRANK PINS AND AXLES BY ROLLING

and Fig. 2 the one used for axles. The rollers are made as hard as possible.

Their practice is to take a smooth cut over the surface before rolling, and to operate the tools with a 1/16-inch feed.

It sometimes happens that the metal seems to rise up a trifle after being rolled and when this occurs the direction of the work is reversed and the roll again applied, which usually gives the desired result.

The advocates of the method lay stress on the fact that the wearing surface of the metal is compressed by this means, and that it increases its wearing qualities.

A machinery exhibition is to be held at Olympia from September 19 to October 19. This exhibition has now become an annual affair, and promises this year to include many novel and interesting features.

Case-hardening the Alloy Steels

Selecting the Best Alloys, the Proper Carbonizing Materials, and Giving the Correct Heat Treatment Secures Satisfactory Results

BY E. F. LAKE

Many of the high-grade alloy steels, which give very high figures in their strength test, are made hard enough to resist wear for such parts of machinery as gears, cams, ball races, etc., by hardening and tempering; but when the proper degree of hardness is obtained to reduce wear to a minimum, they are too brittle to withstand shock strains.

For this reason case-hardening, carbonizing, or as it is called in Europe, "cementation," is resorted to, as by this process the outer shell can be made hard enough to resist wear and the core of the piece can be left soft enough to withstand the shock strains to which it is subjected. Thus with some of the vanadium and nickel-chrome steels, gears such as are used on automobiles can be made that will reduce the wear to a point that would have been considered impossible a few years ago, and at the same time resist shock to such an extent that it is very difficult to break out a tooth with a sledge hammer.

Special Steels for Carbonizing

As a general rule the alloyed steels which give the best results in annealing, hardening and tempering are not the best for carbonizing; for this reason most of these alloyed steels are made in a special grade for carbonizing. As an illustration of this, vanadium steel that gives the best results for crank-shafts, transmission shafts, connecting-rods and other moving engine parts is composed of 0.25 to 0.30 per cent. carbon, 0.40 to 0.50 per cent. manganese, 1 per cent. chromium and 0.16 to 0.18 per cent. vanadium, while the best carbonizing steel has from 0.12 to 0.15 per cent. carbon, 0.20 per cent. managanese, 0.30 per cent. chromium and 0.20 per cent. vanadium.

The result of the carbonizing operation is determined by five factors, which are as follows: First, the nature of the steel; second, the nature of the carbonizing material; third, the temperature of the carbonizing furnace; fourth, the time the piece is submitted to the carbonizing process; fifth, the heat treatment which follows carbonizing.

Penetration of the Carbon

The nature of the steel has no influence on the speed of penetration of the carbon, but has an influence on the final result of the operation.

If steel is used that has a carbon content up to 0.56 per cent., the rate of penetration in carbonizing is constant; but the higher the carbon content is, in the core, the more brittle it becomes by prolonged annealing after carbonizing. Therefore it is necessary that the carbon content should be low in the core, and for this reason a preference is given to steels containing from 0.12 to 0.15 per cent. of carbon for carbonizing or case-hardening purposes.

Some, however, prefer a steel containing from 0.20 to 0.22 per cent. carbon, owing to its being more easily worked with machine tools; but the results will not be as good as with a steel containing a maximum of 0.15 per cent. carbon. Greater strength and easier working qualities can be obtained by the addition of such alloys as chromium, vanadium, nickel, etc.

It is also very important that the manganese content of carbonizing steels be kept low. This should never exceed 0.35 per cent., as manganese has a tendency to render the hardened and carbonized surface brittle, thus making it liable to chip and break at the least shock.

Effect of Various Alloys

Thus manganese is usually kept down to 0.20 per cent. and seldom exceeds 0.25 per cent.

While chromium has a tendency to produce a brittle hardness in steel, it prevents the development of the crystalline structure under heat treatment, thus refining the grain and making it better able to withstand shocks. Therefore chromium added in small percentages makes steels for carbonizing more homogeneous and imparts to them greater strengths and wearing qualities. Chromium, however, produces steels that are very difficult to machine; it is therefore combined with other ingredients which offset this, except for such uses as armor plate.

Vanadium used in homeopathic doses overcomes this difficulty of machining chrome steels to such an extent that it is claimed that a steel containing 1 per cent. chromium and from 0.16 to 0.18 per cent. vanadium can be forged and machined after heat treating as easily as a 0.40 per cent. carbon steel.

Vanadium also produces high dynamic strengths, which gives the core of carbonized steels a high resistance to shocks.

Nickel Offsets Brittleness

Nickel added to ordinary carbonizing steel in comparatively small percentages obviates the brittleness which is usually produced by carbonizing and makes it more homogeneous, the pearlite being distributed much better. With 2 per cent. of nickel the steel is increased in strength; in some cases this strength is nearly double that of the ordinary carbonizing steel, but 2 per cent. nickel steel means nothing unless the carbon is of the proper percentages. When it is, it makes one of the best steels, when carbonized and tempered, for such parts as shafts, ball races, gears, etc. It should therefore be used wherever the 2½ cents difference in price does not make it prohibitive, except where the higher-priced alloy steels are demanded, owing to their greater strength and wearing qualities.

The Surface and the Core

A 2 per cent. nickel steel carbonized so that the surface layer contains about 1 per cent. of carbon will be pearlitic, but a 7 per cent. nickel steel will show a surface layer that is martensitic, with a pearlitic core. Martensite being a constituent of quenched steel, a 7 per cent. nickel steel, carbonized so the surface layer contains 1 per cent. of carbon, has the same constitution as an ordinary carbonizing steel which has been carbonized and hardened, that is, a pearlitic core and a martensitic outer shell. This martensite should become denser and denser as it approaches the outer surface.

If this 7 per cent. nickel is carbonized to a greater depth, so that the surface layer will contain 1.5 per cent. of carbon, the core will be pearlitic and resist shock to a great degree. A martensite layer will be next to the core and close to the outer layer. This will give high strengths and the outer layer will readily polish without wear, thus giving it valuable wearing qualities.

How It Simplifies Case-hardening

This simplifies the processes of carbonizing, owing to its doing away with the hardening processes afterward, but the carbonizing and the cooling afterward must be carefully done in order to get good results from this process.

If, however, the proper carbonizing materials are used, the heat of the furnace regulated so that it remains steady and at the proper temperature, and the piece not cooled too quickly, a saving in time and expense can be made with this process of carbonizing, when this grade of steel is suitable.

The influence of the different elements on the speed of penetration of the carbon, when carbonizing steels containing the same amount of carbon and different

percentages of manganese, chromium, nickel, tungsten, silicon, titanium, molybdenum and aluminum, is shown by Table 1.

The rate of penetration for ordinary carbonizing steel under the same conditions would have been 0.035 inch. Thus it will be seen that manganese, chromium, tungsten and molybdenum increase the rate of penetration. These seem to exist in the state of a double carbide and release a part of the cementite iron.

Nickel, silicon, titanium and aluminum retard the rate of penetration—5 per cent. of silicon reducing it to zero—and these exist in the state of solution in the iron.

The Carbonizing Materials

The nature of the carbonizing materials has an influence on the speed of penetration and it is very essential that the materials be of a known chemical composition, as this is the only way to obtain like results on the same steel at all times.

These materials or cements are manufactured in many special and patented preparations. The following materials are

Penetration of Carbon Per Hour

Component of Alloys.	Speed of Penetration Per Hr. in Inches.
0.5 per cent. manganese	0.043
1.0 per cent. manganese	0.047
1.0 per cent. chromium	0.039
2.0 per cent. chromium	0.043
2.0 per cent. nickel	0.028
5.0 per cent. nickel	0.020
0.5 per cent. tungsten	0.035
1.0 per cent. tungsten	0.036
2.0 per cent. tungsten	0.047
0.5 per cent. silicon	0.024
1.0 per cent. silicon	0.020
2.0 per cent. silicon	0.016
5.0 per cent. silicon	0.000
1.0 per cent. titanium	0.032
2.0 per cent. titanium	0.028
1.0 per cent. molybdenum	0.036
2.0 per cent. molybdenum	0.043
1.0 per cent. aluminum	0.016
3.0 per cent. aluminum	0.008

Table 1

used and compounded in these preparations, but many of them give as good results when used alone as when compounded with others in varying percentages: Powdered bone; wood charcoal; charred sugar; charred leather; cyanide of potassium; ferro-cyanide of potassium; bichromate of potassium; animal black, acid cleaned.

Liquid and Gaseous Agents

Another form of carbonizing materials, which is used a great deal in the large manufactories, is the hydrocarbons, such as illuminating gas, gasolene, etc. These act by dissociation and are not definite enough for the high-grade alloy steels or positive enough for the best results obtained by carbonizing.

Such materials as bone and leather should not be used alone or in combination, as it is impossible to obtain definite results from them, owing to the changeability of their chemical composition when subjected to a temperature high enough for carbonizing.

Wood charcoal is very largely used in carbonizing steels, but the value of this material varies with the wood used, the method employed in making the charcoal, and other factors. Used alone it gives the normal rate of penetration for the first hour, but after that the rate gradually decreases until at eight hours it gives the lowest rate of penetration of any of the carbonizing materials.

Why Effect of Wood Charcoal Decreases

This is due to the fact that wood charcoal contains a percentage of carbonate of potassium, and this, in conjunction with the charcoal and the nitrogen of the air, in the carbonizing case, is capable of giving cyanide of potassium. Thus, by combining wood charcoal and carbonate of potassium, an increase in the rate of penetration can be obtained; but this speed decreases with time, and the exhaustion of the cement is due to the volatilization of the alkaline cyanides. If a current of ammonia is used, the rate of penetration becomes constant, as cyanide of ammonium is formed, and this is the one and only cement. Therefore the best carbonizing materials are the ones that produce the most of this element, as, no matter what the cement is, if it is used in the presence of a current of ammonia the rate of penetration remains constant.

Powdered charcoal and bone gives good results as a carbonizing material and is successfully used in carbonizing nickel-chrome steel by packing in a cast-iron pot and keeping at a temperature of about 2000 degrees Fahrenheit for four hours, and then cooling slowly before taking out of the pot or uncovering.

Action of Pure Carbon

Pure carbon, such as that of sugar, does not carbonize in vacuum; therefore a cement that is simply composed of carbon cannot act directly, but acts simply by dissolution of the carbon, starting with the iron in contact with it. Thus sugar should be mixed with some other material that will overcome this, in order to obtain the best results from carbonization.

Carbonic oxide, giving $2CO = C + CO_2$, which is formed by the action of the air, in the carbonizing box, on a cement that is composed simply of carbon, may act; but its action is slow and the carbonic acid, CO_2, has a decarbonizing action. This is the action which sugar, animal black (acid cleaned), etc., have.

Materials containing a cyanide act by means of the cyanogen radical $(CN)^2$. This compound is decomposed and replaces the carbon; it is in this manner that cyanide of potassium acts. The product is capable of producing cyanide, which is the case with a large number of cements.

Cyanide of Potassium

Ferro-cyanide of potassium gives cyanide, cyanate of potassium and oxide of iron. The mixture of ferro-cyanide and bichromate of potash gives rise to a new mixture of cyanogen and cyanate diluted in a mass of iron and chromium oxide. This mixture and carbonate of barium are subjected to the same conditions. In fact, the mixture, in the presence of the nitrogen of the air, gives rise to cyanide of barium according to the following equation: $2N + 4C + CO_3Ba = (CN)_2Ba + 3CO$. Therefore it acts by means of cyanide and carbonic oxide.

Certain carbonizing materials contain carbonates that are not dissociable at the temperature of carbonization, especially calcium carbonate. In the presence of carbon there is formed carbonic oxide, which carbonizes very slowly.

Classifying Carbonizing Material

Therefore the carbonizing materials might be classed as follows: First, cements which act by means of carbonic oxide; second, cements which act by means of a cyanide, such as potassium, barium or ammonium; third, cements which act by means of hydrocarbons.

The nature of the cement has a very

Temperature in Degrees Fahrenheit.	Cements Used and Rate of Penetration in Inches.			
	Charcoal 60 per cent. + 40 per cent. of Carbonate of Barium.	Ferro-cyanide 66 per cent. + 34 per cent. of Bichromate.	Ferro-cyanide Alone.	Powered Wood Charcoal Alone.
1300	.....	.....	.....	.....
1475	0.020	0.033	0.020	0.020
1650	0.088	0.069	0.079	0.048
1825	0.128	0.128	0.128	0.098
2000	0.177	0.177	0.198	0.138

Table 2

pronounced effect on the rate of carbonization, or the percentage of the carbon content in the surface layer of the piece, or both.

The speed of penetration caused by the action of different cements at different temperatures for the same time, i.e., eight hours is best shown by Table 2.

Another Test of Penetration

At the same temperature, i.e., 1825 degrees Fahrenheit, for different lengths of time and with different cements, the rate of penetration obtained was according to the Table 3.

Eighty per cent. charcoal + 20 per cent. carbonate of barium, 40 per cent. charcoal + 60 per cent. carbonate of barium, ferro-cyanide alone and 66 per cent. ferro-cyanide + 34 per cent. bichromate were used with practically the same results for eight hours' time.

These tables show that charcoal when used alone gives the slowest rate of penetration; but when combined with carbonate of potassium and subjected to a temperature of about 1800 degrees Fahren-

heit for eight hours it gives the highest penetration; or, when combined with carbonate of barium under the same conditions—first table—its speed of penetration is about double that of the other cements; also that a rise of temperature of 175 degrees doubles and, in some cases more than doubles, this rate from 1500 to 1800 degrees temperature.

Effect of Temperature

Thus the temperature of the furnace has a great influence on the rate of penetration, as well as the cement used; therefore it is necessary that the temperature be kept at a definite point in the carbonizing of the high-grade alloy steels, which can be done only by attaching to the furnace something to gage the heat, such as a pyrometer.

If the temperature is too high, the metal is liable to crystallize and the core will rapidly become brittle.

The temperature to which the metal can be safely raised in carbonizing varies with the kind of steel used. As a general rule the ordinary carbonizing steel cannot be raised to a temperature in excess of 1600 degrees Fahrenheit. If the original carbon content is high, even this temperature cannot be safely reached, while with some of the alloy steels, such, for instance, as nickel-chrome steel, a carbonizing temperature of 2000 degrees can be retained for four hours without the core crystallizing, and the rate of penetration will be reasonably high.

Length of Time in Hours.	Cements Used and Rate of Penetration in Inches.				
	Carbon 60 per cent. + 40 per cent. of Carbonate.	Ferro-cyanide 66 per cent. + 34 per cent. of Bichromate.	Powdered Wood Charcoal Alone.	Charcoal and Carbonate of Potassium.	Unwashed Animal Black.
1	0.031	0.033	0.028	0.059	0.035
2	0.039	0.037	0.053	0.078	0.059
4	0.047	0.049	0.063	0.094	0.088
6	0.078	0.074	0.072	0.110	0.106
8	0.118	0.128	0.098	0.138	0.128

TABLE 3

The Lower Limit of Carbonization

The temperature, however, must be kept above 1400 degrees Fahrenheit, as ordinarily carbonization cannot take place below that point, although in an experimental way steel has been carbonized at about 850 degrees by using a mixture of cyanide of potassium, chlorides of the alkalies, and the alkaline earths, the latter being used to lower the fusion point of the cyanide.

The Time Required

The time the piece is submitted to the carbonizing temperature has essentially the same effect as the degree of temperature. Up to a certain point, the longer the time the deeper will be the penetration of the carbon, and the effect of the changes in time is about the same as that of the changes in temperature.

The heat treatment following carbonizing should be very carefully done, owing to the fact that the piece must have a very hard outer surface to resist wear and a non-brittle core that will resist strains; also, some methods of heat treating have a decarbonizing effect, and some of the alloy steels have a tendency to produce cracks or fissures and to warp. Thus crank-shafts for internal-combustion engines were formerly carbonized and hardened, but owing to the difficulty of preventing cracks and warping, this practice has been abandoned.

Annealing after Case-hardening

As a general rule the piece should be annealed after carburizing. This can best be done by leaving it packed in the carbonizing case, with the cover fastened on, and allowing it to cool gradually; but if the carbonizing temperature is not over 1600 degrees Fahrenheit, it can be allowed to cool to 750 degrees, then reheated to 1400 degrees and quenched with good results.

If the carbonizing temperature is a high one, i.e., above 1800 degrees, the piece should be allowed to cool, then reheated to 1650 degrees, and quenched and reheated again to 1400 degrees and quenched.

The reason for the double quenching is that the piece must be heated to above its point of transformation, i.e., 1650 degrees, to destroy the crystallization and consequent brittleness, which is liable to be in the core when it is carbonized at a high temperature; but this leaves the carbonated surface layer not hard enough to resist wear, therefore it must be quenched again at 1400 degrees.

This Temperature Varies

This point of transformation varies with the different components of the high-grade alloy steels, and this should be ascertained before hardening the piece.

Another point might be mentioned in closing, and that is that all steels do not retain their carbonization. One specimen was examined by taking a very thin cut from the outer surface for a part of its length which on analysis showed 1.25 per cent. of carbon. The piece was then laid aside for six months, and a similar cut taken from the rest of its length, which on analyzing showed only 0.92 per cent. of carbon. This showed that the carbon dissolved little by little into the mass.

Small Points Often Overlooked

If carbonizing and tempering afterward are properly done, the alloy steels show some surprising results as to strengths and wear; but in this age of rush, many of the small things are neglected, which in the results obtained may prove very important. They may even destroy all the good qualities of the special steels, rendering them no better than ordinary steels. But if care is used in selecting the steel, knowing its properties, selecting the cement, regulating the temperature and time with precision and performing the annealing and hardening correctly, very satisfactory results can be obtained from carbonizing the high-grade alloy steels.

Small Furnace for Special Work

By F. H. Neely

Not being able to obtain satisfactory results with any high-power crucible furnace that could be found upon the market, the following construction was designed and put into successful operation on crucible steel and special irons, such as are required in novelty and similar work. The simplicity of construction and operation, combined with high heating efficiency, cannot be equaled in any furnace for similar purposes that has come to my attention.

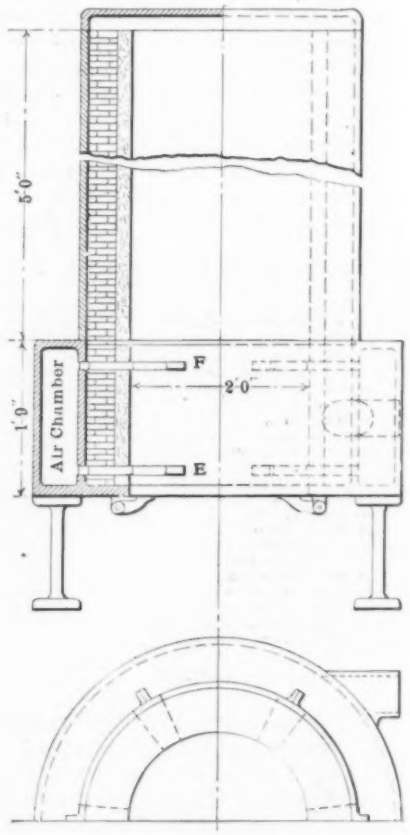


FIG. 1. GENERAL DESIGN OF FURNACE

Fig. 1 shows the general make-up as the furnace stands. It consists essentially of castings made from only four different patterns, namely: the base or "wind box," the vertical stays, the drop doors and the cover.

It was desired to have the design such that the furnace might be used either as a crucible or a cupola type; to obtain this end the blast box was necessarily made

deep enough to take two rows of tuyeres (shown at *E* and *F*), which renders the construction interchangeable. The box is a single, circular casting cored out, as shown, for the air chamber to feed the tuyeres. On the bottom an annular flange extends in, to serve as a support for the fire-brick and clay lining. The top of this wind box is recessed to take the vertical stays, which are six in number and are bolted to each other in cylindrical form. This supports the brick and clay lining, which extends to its top.

On the bottom of the base are cast lugs for the feet and hinge supports for the drop doors, the doors consisting of two semi-circular castings, which are held closed by ordinary props when the furnace is in operation.

As a Crucible Furnace

As above stated, this furnace has the unique feature of being so made that it can be used for either crucible or cupola work. When used as the former, the furnace is of course set in a pit so that the top is about level with the floor, facilitating handling of the pots. The top set of tuyeres is bricked up while the air is blown through the lower ones. By use of the forced draft we are enabled to obtain our high heating power, which will melt crucible steel with ease. The stool, upon which is our melting crucible, rests directly upon the drop doors, the whole being surrounded by coke to its top—this being the hottest point.

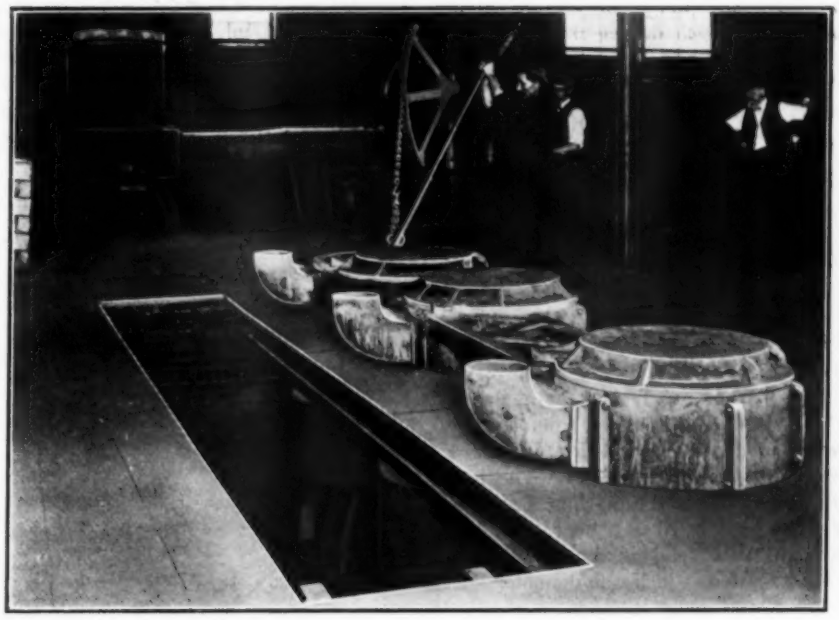


FIG. 3. USED AS A CRUCIBLE FURNACE

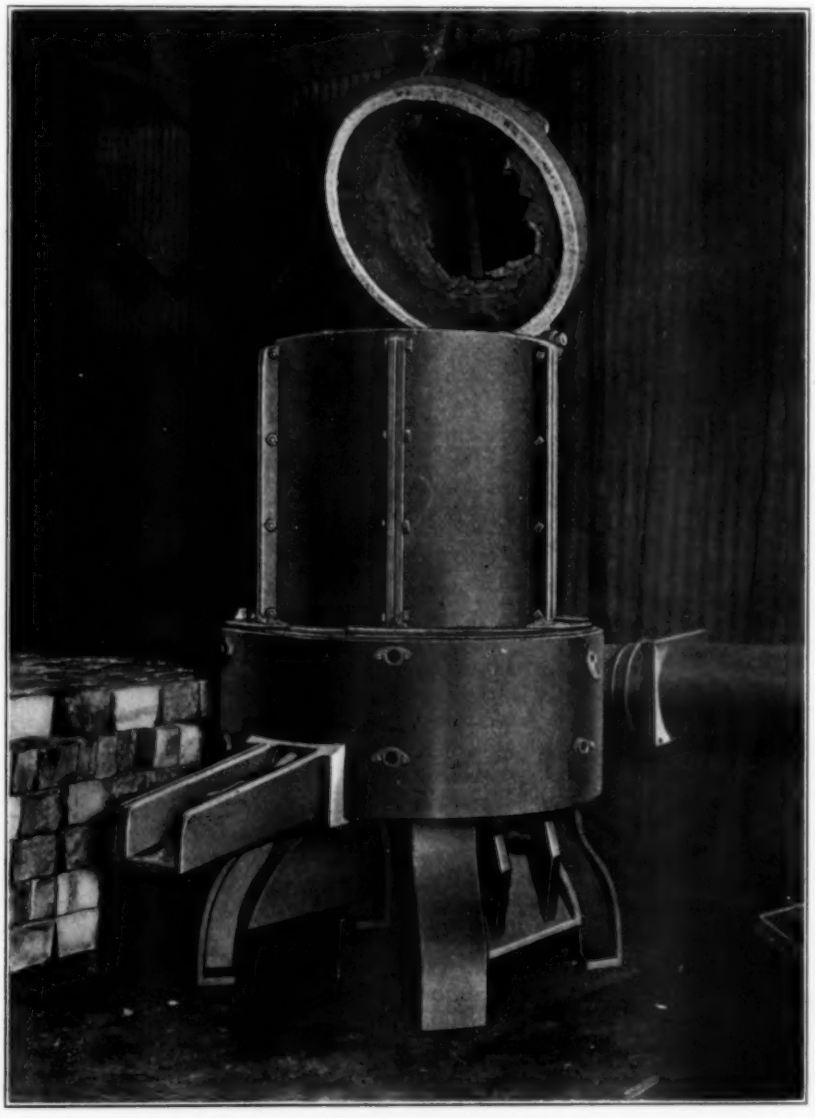


FIG. 2. FURNACE USED FOR CUPOLA WORK

The cover remains closed while blowing, the gases escaping by a flue opening just below the top cover, as can be clearly seen in the photograph. So perfect is the combustion that the fumes are not noticed in the building.

It may be interesting to note here that there is a considerable saving made by using old burnt-out crucibles for "stools," thus eliminating the expensive graphite stool blocks, which in a furnace of this heat soon burn out. The old pot is filled with fire clay, thoroughly dried and set inverted in the bottom of the furnace.

As a Cupola

To make available for a cupola, an arch is cored through the blast box and the outside machined for fastening a well lined trough, as can be seen in the photograph. The lower tuyeres are closed and the blast is admitted at the top set. The bottom doors are blocked up and several inches of sand is rammed on the bottom up as high as the bottom of the outlet trough. The charging is done as usual, a coke bed first extending several inches above the tuyere line and then alternate layers of coke and metal. The operating is just as in an ordinary cupola, the charge melting down very quickly.

This furnace could be made of much larger capacity as a cupola by extending

the stays and lining higher up, giving room for a much deeper charge.

The photographs show the plant as it is in operation; three crucibles and one cupola are installed and in active service.

Making Wooden Rolls for Textile Machinery

By G. A. Dexter

In several branches of textile machinery large wooden rolls are used, varying in length from 4 to 12 feet (as in Fig. 1). These rolls are anywhere from 20 to 36 inches in diameter, and are driven by gears or by friction pulleys. The latter are preferable, as the machine has sometimes to be stopped in a hurry. Running through these rolls is a shaft varying from 1 15/16 to 5 inches in diameter.

There are many different methods of boring the holes through the logs for these shafts. Having tried a number of different ways, I think the one here described is the best yet. The logs used for this work are generally maple, sycamore, buttonball and tamarack, the first-named being the most popular. One reason is that it is cheapest, another that the knots do not as a rule go below the bark more than 1 to 2 inches, and, further, there is less danger from checking or splitting the logs when wedging around the spiders.

Having selected the log most suitable, we proceed to saw it off about 4 inches longer than the finished roll; then chop off the bark. Having done this work outside the shop, we now bring the log inside to the lathe and drive a clamp or dog (Fig. 2) in on one end; then hoist the log on the lathe and place one end in the chuck. Or, if there is no chuck large enough, we have four pieces of 6x6-inch angle iron, as in Fig. 3. These irons we bolt loosely to the large face plate, and then through the other hole we put in a long bolt connecting two irons opposite one another. The idea of this is to tighten on the log and then to tighten on the face plate for driving.

The Tools Used for Turning

Having centered the log in the lathe, turn it up true as far as possible. The tool used for this purpose is made like Fig. 4, being about 3/16 inch thick on the bottom and tapered to a knife edge on top. Having turned up as far as we can, face up the end, then put the rig shown in Fig. 5 under the roll. The wheels of this are adjustable to various diameters.

We then take the tailstock off the lathe and bore the hole through with the tools shown in Fig. 6. On long rolls we bore from each end, to help eliminate the error. After boring the hole to the right size, we next counterbore for the spider, which is keyed onto the shaft. I might here say that a good many firms use a spider like Fig. 7, but I have found that a more convenient style, and one which has given better results is like Fig. 8. We bore out to diameter across flat, and at a depth of about 3 inches. We then bore out a slot for a wrought-iron ring placed as described later.

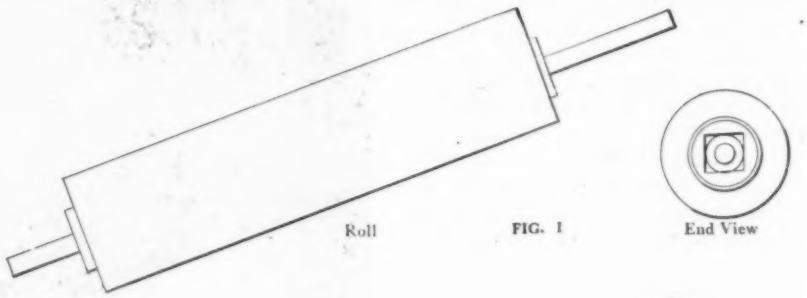


FIG. 1

FIG. 3
6 Angle Iron

FIG. 4
Knife Edge Tool

FIG. 2
Clamp or Dog

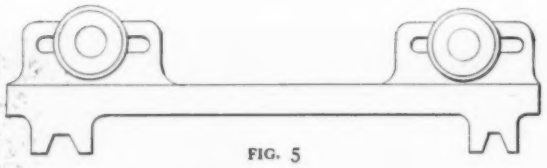


FIG. 5

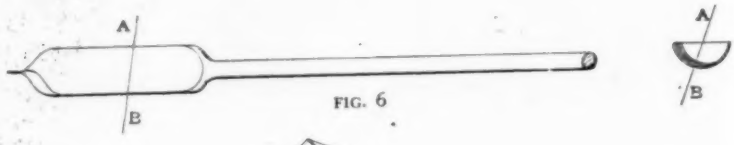
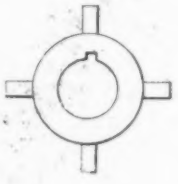
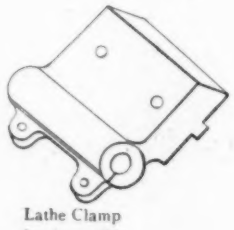


FIG. 6




Lathe Clamp
for Auger Bit

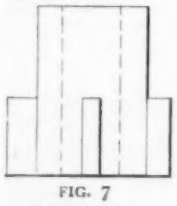


FIG. 7
Pronged Spider

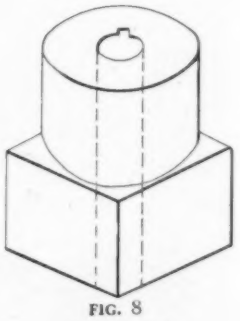


FIG. 8
Square Spider

MAKING WOODEN ROLLS FOR TEXTILE MACHINERY

We are now ready to take the roller out of the lathe, and cut out the square corners for spiders. Having done this, take the shaft (having previously keyed the spider on one end) and drive through the roll until the spider is solidly in place. We then drive on the ring for which the slot was made a tight fit on the inside and ¼ inch larger than the outside diameter of the ring. The idea of being larger on the outside is to prevent splitting of the roll when wedging. Next we drive in between the spider and the ring twelve wedges about 5 inches long, so as to have the roll firmly fastened to the spider. These wedges are 2 inches wide by ½ inch thick.

Reversing the Roll

Now turn the roll around and place on centers in the lathe. Then turn off the part we were unable to touch on account of the chuck; face the roll up on end to the right length; counterbore for the spider and the ring, as before described, swing the roll across the lathe, put in the spider, the key and the ring, then wedge as before. We now true up the

shaft and turn the roll to the diameter that is wanted. By careful boring in the manner described, we are able to use over again shafts from old rolls which, if trued up by being sprung in driving into the roll, would be useless unless the pulleys were bushed.

I will now describe the rolls which have to be from 8 to 12 feet long, but only 9 to 12 inches in diameter. It is evident that if we were to make these the same as described above they would prove very costly. On this class of roll we get a 2-inch square bar of iron and, having centered the ends, get two pieces of timber 6x12 inches and mortise out on one side of each in the center a slot 2 inches wide by 1 inch deep. We take the iron bar and divide the length of the roller so as to allow five bolts on about 8 feet in length. We then drill five ⅝-inch holes through. Then placing the bar in the wood, we bore out the ⅝-inch holes, using the bar as a templet. We then counterbore down on the outside of the timber for bolt heads and nuts, and then bolt securely together; we plug up the holes over the bolt heads and nuts. Next we bore a series of holes in the wood and drive in wood dowels, swing in the lathe and turn up to the diameter wanted. This makes a convenient and cheap way of making these rolls.

Use of High-speed Steel

By J. Watson

Perhaps some of my experiences will interest users of high-speed steel. As our work is entirely in wrought iron and steels ranging from 8 to 80 point carbon, I will necessarily confine my remarks to these metals.

I find that in wrought iron the decrease in cost by the use of high-speed steel over the old style mushet is very small. But on steel of 8 to 10 point carbon there is scarcely a limit to the speed you can run after the scale has been removed. In everyday practice I run at 85 feet per minute and 1/16-inch feed to rough, 250 feet to finish; 45 feet to rough thread and 25 feet to finish it. On steel of 60 to 80 point carbon I use a speed of 45 to 55 feet with same feed to rough, 30 feet to finish, 25 feet to rough thread and 20 feet to finish thread. I might add that these threads are required to have a "looking-glass" finish.

As we have from ¼ inch to ¾ inch stock to remove according to the blacksmith's accuracy, we find that the machinist's time is reduced nearly one-half over the time required before the advent of the new high-speed steels.

I also agree with others in the statement that the steel must be heated *white hot* but will go this one better and say that I get still better results where I heat the roughing tools till the point melts or runs.

Casting Finished Bearings Accurately

Editorial Correspondence

In making some of the bothersome parts of the California adding machine, the superintendent, P. J. Lennon, has displayed his ingenuity in many ways.

Some of these parts are stamped of sheet metal, and have shallow radial slots milled across the face. In order to turn these out rapidly a fixture was made to hold three of these pieces in a circle, as shown in Fig. 1.

This was then mounted on a little Slate automatic pinion cutter, and the difficult part was to make the whole operation automatic so the machine would jump the indexing from *a* to *b*, *b* to *c*, *c* to *d*, *d* to *e* and *e* to *f*.

To accomplish this, three pieces were made to go over the notches in the index wheel at the proper place, and the pawl movement so arranged that it would drop back over the blank piece and pick up the first tooth or notch behind it. In this way the machine is made to feed tooth by tooth till one piece is finished; then comes the jump or long indexing from one piece to the other, after which the regular feed proceeds till the end of the next piece.

Another job on this machine is shown in Fig. 2; but after the other this seems easy, as it is simply a case of putting a special indexing wheel on the machine with teeth cut to correspond.

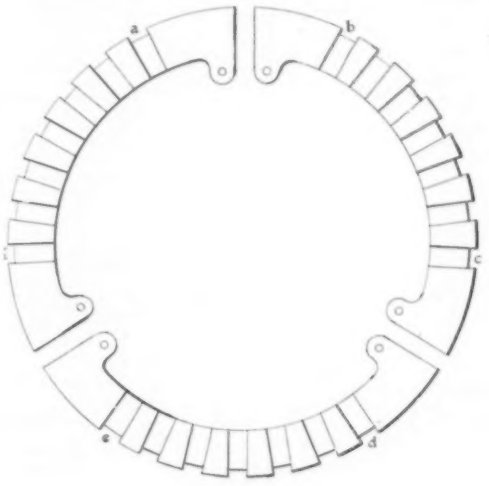


FIG. 1

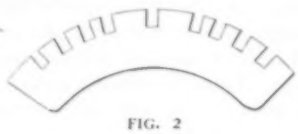


FIG. 2

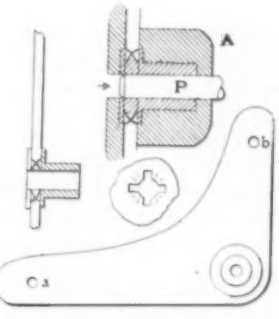


FIG. 3

THREE NEAT JOBS ON AN ADDING MACHINE

Casting in a Small Bushing

The casting of a bushing on a piece of sheet steel is something new to most of us, but Mr. Lennon accomplishes it in a very neat way, and makes a perfect job at a much lower cost than it could be made in a screw machine and riveted in place, even if such a method would give the desired accuracy, which would not be the case.

This is shown in Fig. 3, where the outside length of the bushing must be the same whether the sheet metal varies in thickness or not.

The bushing must be exactly located with reference to two other holes, *a* and *b*, in the sheet, and the hole to receive it is drilled in a jig with pins at these points. Then a milling cutter gashes into the hole to make places for the metal to flow, these gashes being from each side, so that the inner edge really presents four teeth for the metal to flow around.

Then the plate is clamped between the steel molds as at *A*, again located from the two pin holes referred to, and the metal is pumped into the mold, as indicated by the arrow in the sketch. The plunger *P* forms the core, and also serves to compress the metal, to bring it to size, to shut off the flow and to push out the gate or sprue when it moves forward at the right time.

The dies close together so that the only variation that can take place is in the thickness of the flanges; these in most cases are not over 0.02 to 0.03 inch in thickness, so it can be called pretty fine casting.

The metal is a very hard babbitt so proportioned that the shrinkage is very slight, and it makes a good bearing. The plunger leaves the bearing burnished.

F. H. C.

School of Engineering, Colorado College, has been donated $12,000 by William J. Palmer, to be immediately expended on additional equipment of the engineering laboratories for senior work.

Ground was broken for one of the greatest engineering projects of the age on June 20 near Cold Spring, N. Y., west of the Hudson river. Immense reservoirs are to be constructed in the Catskills and an aqueduct is to bring water from there to the city of New York. It is estimated that the work will cost in the neighborhood of $160,000,000 and will increase the present Croton supply about 500,000,000 gallons daily.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Drilling Jig, a Milling Fixture and a Hand Broach

I have been a reader of the AMERICAN MACHINIST for some years, and during that time have gathered much valuable information from letters written by practical men. The racy, humorous manner of Osborn and Dixie in all their various disguises, relating their tight-corner escapades, appears and reappears as thrilling as any Western ranch story. I have during the last few years designed many jigs and fixtures for drilling and milling, which, I boldly assert, came into being partly as a result of others unknown to me who aided me through their writings. A few of these tools may be of interest to others.

The accompanying drawings represent: Fig. 1, a drilling jig; Fig. 2, a small fixture for the milling machine; and Fig. 3, a hand rig for cutting square holes in the end of box keys.

THE DRILLING JIG

The jig was designed for drilling a hole in a special gear wheel where any inaccuracy between centers would multiply to the lever which it operated. It was also necessary that the teeth should bear a certain relation to the hole; hence the tooth lever, which is controlled by the nurled screw. This lever thus locates and binds the jig in position on the gear. The drill bushing is shown at *B*.

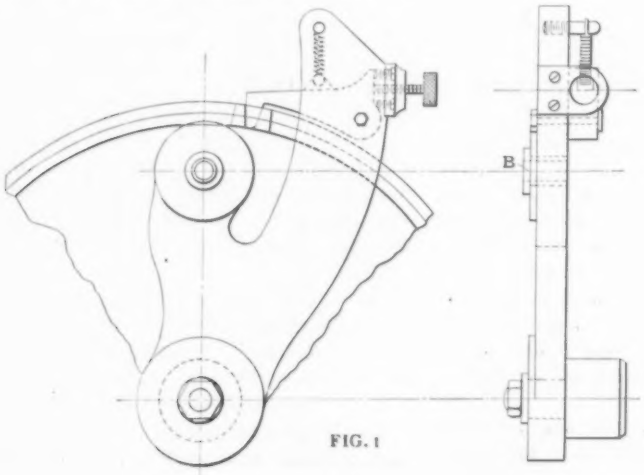


FIG. 1

A GEAR-DRILLING JIG

THE MILLING FIXTURE

The small milling fixture, Fig. 2, was made for use on a hand miller. There are a great many studs, belonging to all classes of machinery, that require two parallel surfaces for fitting into slot holes, to keep from turning when tightening in the desired position. The fixture holds them solidly under a straddle cut. The plate for locating the head of the stud, and the clamping strap, are shown in the details. A bar *C* enters the rectangular hole in the strap and is tightened by the capstan-headed screw.

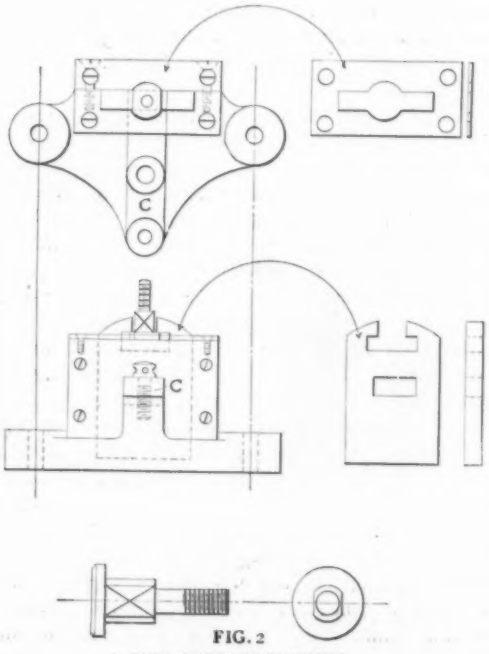


FIG. 2

A STUD-MILLING FIXTURE

THE BROACH

A box key was part of the outfit sent with each of our machines, and until recently it was made under jobbing conditions. A forging was made and drilled to the necessary depth. A square tool was driven into it by the blacksmith while it was hot. It always seemed a pity to see the finish put upon the outside, while the hole itself was dirty with scale and was far from being as square

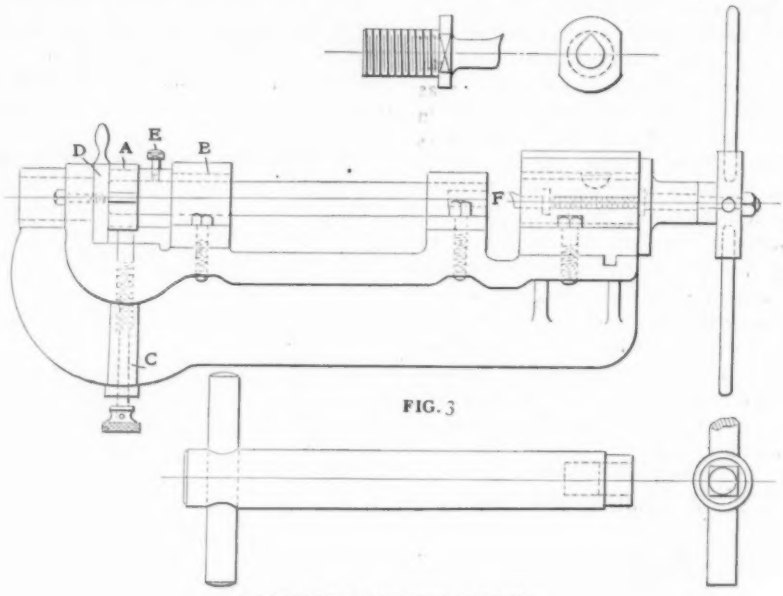


FIG. 3

A WRENCH-BROACHING FIXTURE

as it ought to be. In use, the wrench gnawed the sides of the screw heads as if to compensate for its services. The new tool was made like Fig. 3.

The keys were made in the turret lathe from bright mild steel, ¾ inch in diameter, with a hole 1 inch deep drilled in the end. They were cut off 9¾ inches long. Then they were placed in a horizontal position in the tool (Fig. 3), which was previously gripped in a vise. At *A* is a bushing which rotates in *B* and is divided at each quarter with a space which is located by the pin *C*. At *D* is a strap which is shut when a key is placed in position through the hole from the left-hand side, acting as a bolster under the cutting strain. The screw *E*, when tightened, engages the box key with *A*. The tool *F* is advanced by the screw.

This tool is a right-angle with the round portion made to ride in the hole, thus insuring no spring and supporting the cutting edge. The output is five dozen wrenches in three hours, and with no sweating. This may be a poor performance for some who have arrived at some better way for making square holes. Our consolation is that the quality could not be improved.

Y——, England. ERNEST METCALFE.

Pilots on Taps—Sizes of Tap Drills

It has always been a mystery to me why some tap manufacturer does not establish a good practical shop standard for tap-drill sizes and make pilots on taps to conform with said sizes. When using taps, say from 3/16 up to ½ inch, they are generally started by hand, holding the work in the vise, and as the taper on the tap as now made is a pretty short affair, the tap is invariably started on a slight angle. On small-sized taps the body of the tap is not strong enough to straighten itself if started on an angle. If the tap were made with a pilot it would, however, be easy to start in the vise taps that are now started in the lathe, or in cases where the work is now drilled to insure the tap starting straight.

Another thing that seems erroneous to me is that the sizes for tap drills for commercial and practical uses are too small, or rather smaller than necessary, as the body of the screw is so weak in proportion to the strength of the thread tapped in the work that the screw will twist off when only one-quarter the depth of thread is tapped in the work.

The question of tap sizes would readily be adjusted by the workmen if they were furnished with taps of a certain size having certain sized pilots.

I always use a No. 4 drill for ¼-inch taps in cast iron, and the result is a good smooth thread, plenty strong enough, while, if a nearly full thread be cut, the top of the thread is apt to be "feather-edge" and will crumble, causing the screw to "cut". I hope to see the day when we can start a tap as readily as we can our hand reamers. M. NOTTAR.

Screw-slotting Jaws

On page 924, Part 1, Mr. Little gives the merits of various styles of screw-slotting jaws, and I wish to ask him if he has ever tried two disks clamped together and tapped on the joint? I have only heard of this scheme in a general way, so cannot give all of the details with any degree of accuracy.

The idea is to have two disks *A* and *B*, as shown in section in Fig. 1, as large in diameter as the screw machine will admit of. They are held in a fixture *C* that fits in one of the holes of the turret. These disks are tapped on the joint with

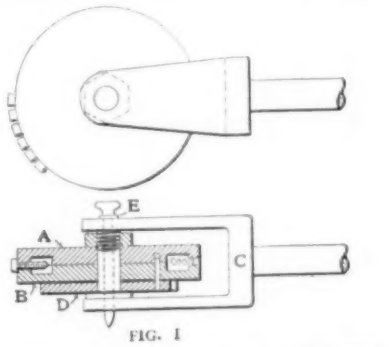


FIG. 1

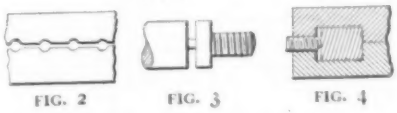


FIG. 2 FIG. 3 FIG. 4

SCREW-SLOTTING DEVICE

a series of holes so the screw thread is half in each disk. The cutting-off tool is so set for depth that it does not quite separate the screw from the bar stock. The final move of the turret brings up the arrangement shown in Fig. 1, the screw enters one of the tapped holes, screws itself in good and hard and is twisted off from the parent bar. *D* is a ratchet having the same number of teeth as there are tapped holes in the disks, and a pawl feeds it one tooth for each turn of the turret. After the disks are all filled up with screws, they are taken out of the fixture by withdrawing the pin *E*, and are then placed in the slotting machine, where they are given a slow rotary motion to feed the screw heads past a saw running on an arbor parallel to the pin on which the disks are mounted. These disks are made in duplicate, so that one pair may be in the turret filling with screws as they are made, while the other pair is in the slotting machine.

After slotting all the screws held at one time by the disks, they are taken apart and the slotted screws dumped out. If the disks do not quite meet at their edges, as shown in Fig. 2, it makes the removal of the finished screws a little easier. A single dowel pin through the ratchet and both disks insures correct assembling each time. The cutting-off tool can be slightly beveled on the end so as to leave the neck a little thinner on the side next to the head, as shown in Fig. 3, and then no tit will be left on the screw head. This beveling scheme, of course, is a well known dodge, only with the rig shown here it does not have to be beveled so much as where the cutting-off tool actually separates the finished screw from the bar.

The ratchet *D* can also be utilized in the slotting machine to give the disks a slow rotary motion by means of a reciprocating pawl. As an economy in construction, the disks might be recessed so there would be no blind holes to tap. Then if the disks are to be used at any time for headless screws, the recess can be filled up with a separate ring for the screws to seat themselves against, as shown in Fig. 4, the outside diameter of the rings being varied to suit the various lengths of headless screws. For shouldered screws the disks may be counterbored so the screw heads will bear directly against the edges of the disks, and thus get a firm support; while for countersunk screws, the outer ends of the tapped holes may be countersunk to match the screw heads.

The holes tapped in the edge of the disks should be as close together as the maximum diameter of head for that particular screw thread will allow. The holes might be drilled and tapped while the fixture is in place in the turret. In the event of a small lot of screws being made with unusually large heads, the indexing device might be made to feed two teeth of the ratchet each time, and so fill every other hole with screws. This would necessitate taking the disks out of the turret oftener, but would avoid making a new set of disks for a short job.

The device here suggested is, of course, only applicable in the case of small screws, and these are probably the ones Mr. Little had the most trouble with.

WALTER GRIBBEN.

More about Piston Pins

At page 386, Part 1, you put the question, What is wrong with piston pins? One can see at a glance what is wrong if he compares the drawing of the half pin with the piston pins figured at page 454, Vol. 29, Part 2; but the matter goes far beyond foisting on the consumer stock that the makers know can be made far lighter and simpler. You have got to deal with flying-machine men who will not tolerate weight and complication at the fiat of any manufacturer.

As an assistance to those who do things because they were done so yesterday, let me point out that the piston pin does

heavy work only on the side toward the crank; therefore I cut off the unnecessary segment of the pins, determined by the ratio of the crank to the rod.

Quite a variety of devices and parts is used to keep the cylindrical pin from shifting endways; all these extravagances are thrown aside by using the half-pin screwed onto or into the center of the piston, on which it bears preferably with a flat surface; the half-pin cannot shift axially, and the rod cannot shift beyond the play allowed by the end flanges.

The half-collars on the half-pins have only to be strong enough to draw the piston outward when turning the engine by hand, or to draw in the charge or scavenging air if these are not under pressure. The half-pin is easily adjustable for wear or to alter the clearance.

The cylindrical piston pin is a ruling size for three-cylinder torpedo engines, and affects the diameter and all connected with that weapon. The length and consequently the weight and cost of every single-acting motor driving a crank-pin are reduced by using the half-pin.

Can any of your statistical readers figure out the saving in the annual output that ensues from the general use of the half-pin? LAW HARGRAVE.

New South Wales.

Hobbing a 25-degree Worm Wheel with a 12½-degree Hob —Hobbing a Left-hand Worm Wheel with a Right-hand Hob

Recently having a worm-wheel to cut, I found that in order to do the job it was necessary to make a hob to suit.

The worm wheel had 24 teeth, 1/7 inch circular pitch, to mesh into a worm having a quadruple thread with a lead of 4/7 inch, or 1¾ threads per inch. The blank diameter of the worm being 0.495 inch, and pitch diameter 0.405 inch, it was found that the angle for gashing would be about 25 degrees.

There being no quadruple-thread hob in the shop to suit the dimensions of worm just given, and as it was thought unwise to make a hob for one gear, I decided to use a hob of the same diameter, the only difference being a double thread, as the case required.

The gear was mounted between the centers of the milling machine, and the saddle swung to an angle of 25 degrees and then gashed in the usual manner. After gashing the gear it was ready for hobbing, and as the angle was quite steep for a small worm it was liable to give some trouble in getting the hob started.

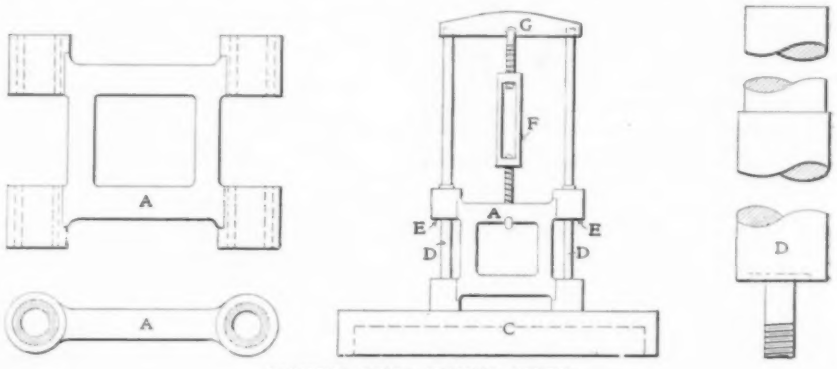
I took the double-thread hob, which was equal to 12½ degrees angle of thread, and instead of bringing the saddle of the milling machine back to zero, I brought it back to 12½ degrees, and hobbed the gear at that angle without a hitch; for leaving the saddle at an angle of 12½ degrees and the hob being equal to 12½ degrees, it gave me the proper angle of tooth as desired. The job was very satisfactory.

Another case I had was hobbing a *left-hand* worm wheel with a *right-hand* hob. The worm wheel required an angle of 3 degrees left hand for gashing. After gashing the gear 3 degrees left hand, I placed the *right-hand* hob on the milling-machine mandrel and swung the saddle 3 degrees more in the same direction, making it 6 degrees left hand, and hobbed the gear. This gave very good results also.

EDW. J. RANTSCH.

Making Some Sliding Yokes

We got the job to make a large number of the yokes shown at *A*. They were made of cast iron and were required to be interchangeable. The first idea was to bore them and an angle plate was rigged up on the face plate of a lathe.



MAKING SOME SLIDING YOKES

The angle plate had a tongue in it which fitted in a groove in the face plate. Two stops were arranged to gage the movement of the angle plate. The pieces *A* were clamped to the angle plate and the first hole bored and reamed. The angle plate was moved over to the other stop, and the balance weight moved over to the other side of the face plate. The second hole was then bored and reamed. Before releasing the work two test plugs were put in the holes and tested for parallel. The holes showed up well. The work was then taken out and another was bored.

About this time it struck me that it might be just as well to test them and see how they compared. They were of no use whatever. The holes were out of line in more ways than I thought possible, so I decided to find another and easier way to do the work and have it right.

The core box for the holes was enlarged so that babbitt metal could be run in around a mandrel. An old narrow surface plate *C* was scraped true and two holes were drilled through it at approximately correct center distances. The plate was faced on the inside to accommodate a nut and washer. Two mandrels like *D* were carefully turned and ground. They were recessed at the bottom to insure their standing perpendicular to the surface plate. After putting them approximately in place they were located to exact position, using a vernier to gage them. The castings were slipped on the two mandrels, with paper washers at *E*. The paper washers were backed up with putty before pouring the babbitt. A small angle plate was fastened to the surface plate and a light clamp was sufficient to hold the yoke *A* while the metal was being poured. The clamp used was a flat piece of spring brass loosely riveted to the angle plate, the idea being stolen from an ordinary photographic printing frame. The mandrels were greased with a mixture of tallow and graphite. A yoke *G* and turnbuckle *F* were used to pull the finished pieces off the mandrels.

The pieces were very satisfactory and when worn in service could be re-babbitted at slight expense. They reciprocated on round guide bars. The spaces in the center, between the bearings, were filled with felt washers, which acted as oil reservoirs. This was an afterthought, but very satisfactory. E. A. DIXIE.

Standardization of Drawing-room Methods

I agree with Mr. Stoneham in his article under this same title, on page 9 of the AMERICAN MACHINIST, that standardization of drawing-room systems and methods is of great importance to the smooth working of any drawing room. I think that a standard size of sheet for each detail is the most satisfactory and economical arrangement. Especially is this the best for the automobile business where there are many small parts in each machine.

At one time I was with a firm who used one standard-sized sheet for all drawings. This system was far better than having no standard at all, but was costly and unhandy at times. The size of their sheets was 24x36 inches. Several small details

were placed on each sheet, which meant a loss of time in looking for any particular one when it was required. If a blue print of one or two details was required it meant a sheet of blue-print paper of the dimensions 24x36 inches. If each detail had been on a separate sheet only a small piece would have been used.

My present firm uses four standard sizes of sheets: 8x11 inches, for details; 20x26 inches, for drop forgings and pattern drawings; 26x41 inches, for small assemblies and any drop-forge or pattern drawings that could not be shown on its regular sheet to good advantage, and 41x any length for full-sized assemblies. All numbers are consecutive, and each model car is given a type number and letter such as G-2, G-3, G-4, etc.

Every part of a car is detailed on a sheet 8x11 inches. These sheets are bound in a folder, thus making a complete book for a machine. A book contains about 1000 blue prints. These books are used—for reference only—by the foremen of various departments, the purchasing agent and stockkeepers. A print mounted on press board is used by the machine operators.

One thousand blue prints, bound in book form, would seem to make a thick clumsy volume to handle. As a matter of fact it makes a book only about five inches thick. This is easily handled. The blue prints are placed in rotation, and each one is numbered in the lower right-hand corner; thus any piece may be turned to at once. The total cost of making such a book is about three dollars. This is inexpensive, considering its usefulness.

The drawings, 20x26 inches in size, are never used outside of the drawing-room and pattern shop, except for mailing purposes to firms who make drop-forgings.

When a change is made in a drawing a new blue print is inserted, and the old one removed. This is, of course, a quick and easy operation.

I would like to hear, through the columns of the AMERICAN MACHINIST in regard to methods for keeping track of changes on manufactured parts. It is my most vexing problem. A. B. HOWK.

A Large Punch and Die

Fig. 1 shows a punch and die for punching a hole 20 inches in diameter with three keyways, in sheets to be used for armature core laminations. Dealing with the die first, the body *A* is made of cast iron, and is machined on the bottom, and in the recess—for locating the segments—only. The cutting ring is built up of nine segments, each held in position from underneath by fillister-headed screws and located by pins. In making the segments a ring is first machined to the required dimensions and is then sawed up into the number of segments required. If a plain hole without any keyways was required to be punched, an extra segment would have to be made to make up for the amount lost, due to the width of the saw in sawing up the segments, but in the tools shown this is not necessary as the parts *B* forming the keyway dies more than make up for the amount lost. The three keyway dies are located in a groove machined in the body and are held in position in the same way as the segments. All cutting parts of the die are made of tool steel and are hardened and ground. The stripping is accomplished by means of a mild-steel plate, machined on top face and outside diameter only, packed underneath with rubber and located, adjusted and held in position by screws with sliding nuts, the latter being prevented from turning round while adjusting the stripper by small pins *C*, one in each nut, driven into the nut and fitting into grooves in the body.

The punch body is made of cast iron, and is machined in the same way as the body for the die. The ring for the punch proper is made of tool steel, and is located and held in position by pins and screws. After being fixed in position three grooves are machined in the body and through the ring, so cutting the latter into three parts; in each of these grooves is located a block *G*, into which the punch for the keyway is driven; both the blocks and punches are hardened, but the ring forming the punch proper was left soft in this case. The stripping arrangement will be clear without description.

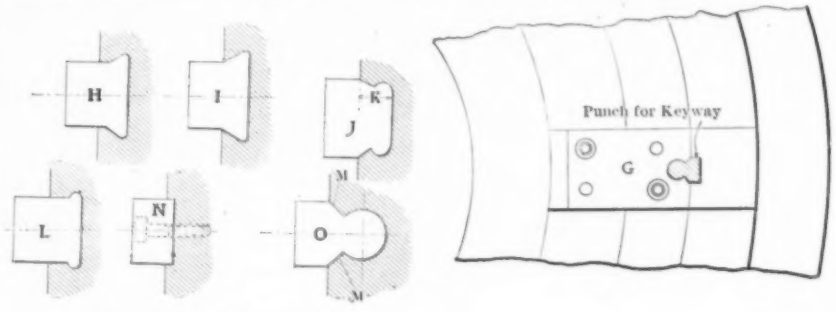


FIG. 2. INSERTED PUNCHES

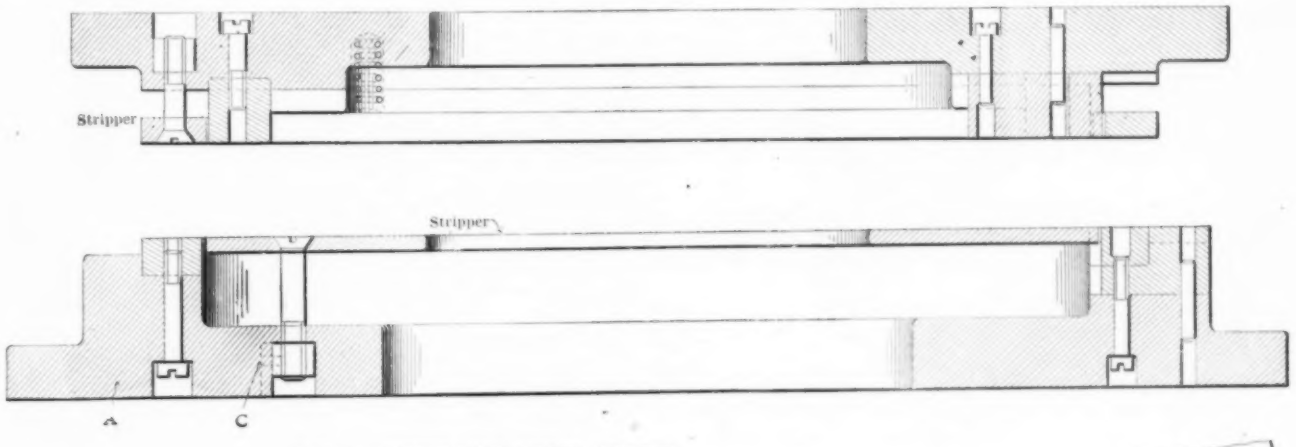
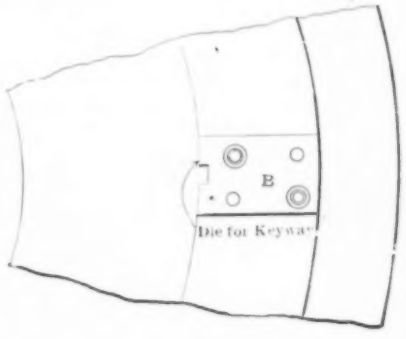


FIG. 1. TWENTY-INCH PUNCH AND DIE



Trouble is sometimes experienced with small inserted parts such as keyway punches. The usual method employed for locating and holding such parts is to locate in a groove and attach to the main part with screws and pins, as at *N*, Fig. 2. After being in use for a little time they sometimes work loose with the result that if it is not noticed the tool may be seriously damaged; besides, owing to the screw and pin holes, they are liable to crack in hardening; this method is cheap and on very light work often answers all right. Usually I employ the method

shown at *O*, which makes a sound job and will hold up to anything in reason. A hole is first drilled in the main part, and then the material from the outside to the hole is machined or filed away, the flat faces *M* being made slightly taper from the bottom upward, the punch being made to correspond and driven in from underneath, so that when in operation the tendency is to force it more firmly into the body instead of to push it out. When a dovetail is used it is best to make it as at *H*, not as *I*, so as to avoid the sharp corners. *L* is a way of doing the job that is not often seen, although it is fairly cheap to make and answers very well. Two holes are drilled in the body, and then a slot is machined, passing through the center to the bottom of the holes, the sides of the slot being made slightly taper to give the same effect as in the method shown at *O*.

J is a development of *O*, and is used for large punches when the depth *K* is limited.

R. CHERRY.

Lead as a Pattern Material

In considering the different materials for use in patternmaking we usually think of pine, mahogany and cherry for ordinary use, or brass and iron for patterns from which a great many castings will be required; but we do not usually think of using as soft a metal as lead. While I would not recommend lead as a suitable material for permanent patterns, experience has shown me that it may be very serviceable in many cases for master patterns, that is for temporary use for getting castings for brass or iron patterns, and also in many cases where but few castings are required, its softness and flexibility, which condemn it for permanent use, making it especially serviceable in some such cases.

It was my fortune to be connected at one time with a concern engaged in the manufacture of fan blowers. The shells or casings of these blowers would range in thickness from about three thirty-seconds of an inch for the smallest ones, which were about twelve inches high, to nearly a quarter of an inch for the large ones, which would stand about five or six feet high.

A side view of one of these casings is shown in Fig. 1, and a sectional view of the same is shown in Fig. 2.

In the first set of patterns which were made the master pattern was made to give only the outside shape; it was not hollowed out at all. In making the iron pattern the molder first molded up this outside shape, and from this he made a reverse mold, which he shaved back to get the required thickness.

The iron patterns obtained in this manner were, however, of very uneven thickness and were much too heavy.

During the time that I was connected with the company the patterns were pretty nearly all made over. In making this second set of patterns we first made a former of the size and shape of the inside of the casing, and on this former we built up the master pattern of sheet lead of the required thickness.

It will be noticed from Fig. 1 that the casing increases in size spirally from *c* around through *a* to *b*. This made it necessary that the former should be largely made by hand, the lathe being of but very little use, the shape being obtained by working it to templets of constantly increasing size. The former being finished, the sheet lead was laid on in pieces of from about 2 or 3 to about 5 or 6 inches square, according to the size of the pattern, the edges of each piece, as they were fitted together, being beveled to make room for the solder. The pieces were temporarily

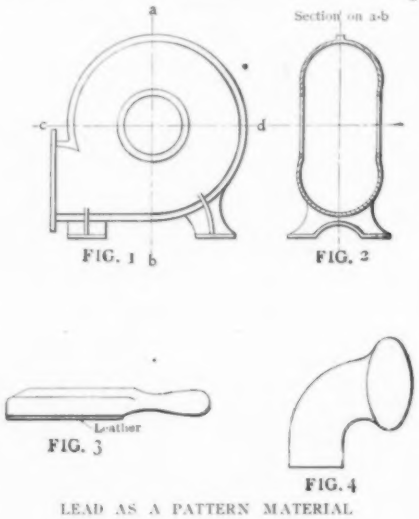


FIG. 1 FIG. 2

FIG. 3 FIG. 4

LEAD AS A PATTERN MATERIAL

held in place for soldering by screws passing through them into the former, the lead being protected from the screws by leather washers. These screw-holes were, of course, afterward soldered up.

In working the lead to shape over the former a beater, as shown in Fig. 3, faced with leather, was used. The shell being made in this manner, the feet, which were made of wood, were screwed on from the inside.

The iron patterns obtained from these lead master patterns weighed from one-half to two-thirds of what the first ones, made by the reversing and shaving-back process of the molder, weighed, making a saving in the final castings well worth while.

As a further illustration of the use of lead in pattern work, we will take the case of the ventilating-funnel top, shown in Fig. 4, which the president of the company had made for his yacht. This was about six inches in diameter at the small end, and tapered gradually toward the flaring, bell-shaped end, which was about eight or nine inches diameter. It is evident that it would have been a slow, expensive, and also a difficult job to have made a wooden pattern and core box of this and get the thickness anywhere near uniform, but by using lead the problem was easy.

In making this we first made a former, in halves, of the exact shape that the core was to be. These formers were then greased, and core boxes were made from them in the usual manner of calcined plaster, that is, each half of the former was inclosed in a box-like frame, without top or bottom, and the plaster, mixed with water to the consistency of cream, was poured over them. After the plaster had set the foremers were removed and sheet lead of the desired thickness was worked over and fastened onto them, to make the finished pattern.

It is evident that castings obtained from this pattern would be uniform in thickness and the pattern cost was small.

F. L. WOODS.

Recutting Micrometer Screws

We had quite a number of one-, two- and three-inch micrometers which had been used so much within a small range that the thread of the screw had become badly worn; some of them, if fairly tight at each end, would shake at the center.

We decided to make an attempt to recut them, and this is the way we went about it. Our shop is not a very large one, but we have a small Rivett bench lathe. In the half-inch collet or draw chuck of this lathe we bored out a piece of cold-rolled shafting about an inch long, until it was a good, tight, wringing fit for the shank of the micrometer screw which carries the movable anvil. This centered it absolutely true, provided reasonable care was used. As very light cuts were all that it was desired to take to true up the thread, the friction of the wringing fit was ample to drive the screw.

The job was made harder by the fact that part of the micrometers were of Brown & Sharpe's make, in which the shank of the screw is pressed into the thimble. Taking out and replacing the screw in these cases required an extra amount of care, or a pretty bum looking job would have been the result. The final results were found to be perfectly satisfactory, and the micrometers, tested after the recutting, compared favorably with new ones. As the nut of the caliper is very short, compared with the screw, that required no repairing.

A. D. UBER.

The employees of Dodge & Day, of Philadelphia, have organized a new engineering society called the Engineers' and Constructors' Club, the object of which is to discuss subjects relating to engineering and construction and to give all members the benefit of the experience gained by each in his particular line. Four meetings have already been held, and the proceedings of the club are to be published regularly.

The Maximus Brake

Some interesting and ingenious mechanical features are comprised in an English invention which may before long be tried in this country. The object of the invention is to increase the efficiency of braking apparatus on railroad trains and to permit of stopping the trains in the shortest possible time. This is done by automatically and constantly maintaining a pressure on the brake shoes up to the maximum permissible without skidding the wheels, a force being applied which at the beginning is 160 per cent. or more of the weight of the vehicle, and which gradually and automatically eases off to 80 per cent. In the celebrated experiments made in England in 1878-79 by Captain Douglas Galton and George Westinghouse, it was shown that the coefficient of friction between the brake shoes and the wheels varies in an inverse direction to the speed of the train; thus at 60 miles per hour the coefficient of friction was 0.074, at 50 miles 0.116, at 40 miles 0.140, at 30 miles 0.164, at 20 miles 0.192, at 10 miles 0.242, and under 5 miles 0.273. This may often be noticed when a locomotive or car is stopping and just before coming to a standstill (if the brakes be not released at this instant) the coefficient rises so high as to lock the wheels, causing them to skid with a loud grunt. From the foregoing it follows that to get, at high speed, a braking effect equal to that at low speed, it is necessary to have a much higher pressure on the brake shoes to compensate for the lower coefficient. Therefore to make the quickest possible stop—which means that in spite of high braking pressure the wheels must not be skidded—if is necessary to gradually reduce the pressure on the brake shoes as the speed is reduced. In the invention referred to, this is accomplished mechanically, without a venting of the air from the brake cylinder, by means of some modifications of the brake rigging and an attachment on one side of the wheel, from which the brake blocks on that side are suspended, and to which is connected an extra rod, which, like the pull rod, comes from the brake cylinder lever and is actuated by the piston, or as is sometimes the case in England, by the diaphragm of the vacuum brake. At the truck end this rod is attached to a ratchet, above which is a pawl, which when engaged tends to prevent any further piston travel or increase of tension on the pull-rod. Normally this pawl is kept out of engagement by the upper arm of the bell crank which carries it being obstructed by the presence of a square shaft running across the truck from side to side. On the ends of the square shaft are mounted the bell cranks from which the brake shoes are suspended. In the fore-and-aft connections running to the brakes on the opposite side of the wheels, 180 degrees around, is contained an important element of the device, consisting of a $<$-shaped cam, the roll being normally at the apex of the $<$; but if the pressure of the brake against the wheel becomes so great as to cause the former to seize and be carried around with the wheel, the roll moves along one or other of the legs of the $<$, according to the direction of rotation, the effect being to exert a pull or a push on the end of the bell cranks and displace them, rocking the square shaft about fulcrum points outside of itself, against the resistance of springs, and freeing the pawl bell crank so that the pawl drops into the ratchet, and insures that there shall be no further piston travel, as previously explained. At the same time the travel of the roll along the leg of the cam causes the brake shoe to recede slightly from the center of the wheel; the greater its arc of departure up or down from the normal level the greater is its radial movement from the center, therefore the greater is the relaxation of the pressure. The proportion of the parts and the resistance of the springs is such that the pressure on the brake shoes is maintained at the maximum permissible at any given instant, gradually decreasing as the wheel slows down and the coefficient of friction increases, so that the product of the latter by the decreasing percentage of the vehicle weight exerted as pressure varies only slightly during the retardation of the vehicle. Tests have been made in England to show the superior retarding effect of the Maximus brake over what is described as "the ordinary brake." In one of these tests a coach on the North Eastern Railway was stopped by the Maximus brake from a speed of 75 miles an hour in a distance of 670 yards, while when equipped with the other brake it took 990 yards to stop the same coach from 74 miles an hour.

Loss of Heat Due to Boiler Scale

By L. P. Breckenridge.

The Engineering Experiment Station of the University of Illinois has just issued Bulletin No. 11, "The Effect of Scale on the Transmission of Heat Through Locomotive Boiler Tubes," by Edward C. Schmidt, M. E., and John M. Snodgrass, B. S. This bulletin describes a series of experiments begun in 1900 by the railway engineering department of the University of Illinois, to determine the relation of the heat loss due to scale to the scale thickness. The experiments comprise tests on single tubes as well as tests of the entire locomotive boiler.

The results of all the tests, plotted with reference to scale thickness, show great divergence in the heat loss, which is ascribed to differences in scale structure. The bulletin is of interest to all who have to do with the operation of steam boilers in localities where pure feed water is not available. The conclusions derived from the tests are summarized as follows:

1. That for scale of thicknesses up to ⅛ inch, the heat loss may vary in individual cases from insignificant amounts to as much as 10 or 12 per cent.
2. That the heat loss does increase with thickness in an undetermined ratio.
3. That mechanical structure of the scale is of as much or more importance than thickness in producing this loss.
4. That chemical composition, except in so far as it affects the structure of the scale, has no direct influence on heat transmission.

Danger of Explosion from Gasolene and Soap

In view of numerous sewer explosions which have occurred, persons concerned with the use of gasolene will be interested in a paper on "Gasolene-Soap 'Emulsions' and their Relation to Sewer Explosions," which was presented before the New York section of the American Chemical Society by A. A. Breneman. According to this paper, the "emulsion" produced by shaking up gasolene or benzine with soap solutions gathers slowly upon the surface of the aqueous liquid, forming a thick, creamy paste which is very permanent in closed vessels but disintegrates rapidly on exposure to air by volatilization of the hydrocarbon. The ordinary operation of washing the hands with soap after benzine or gasolene has been used to remove grease, carries off the light liquid as an emulsion. This same emulsion can be made in quantity by shaking up gasolene with a weak soap solution in a stoppered glass cylinder. It then rises in an hour or less to form a thick, white, creamy layer which can be drawn off and kept separately. In this condition it is very permanent, requiring many days to effect an appreciable further separation. Under the miscroscope it shows a mass of air bubbles studded or coated with minute globules of gasolene. The air within the bubbles is saturated with vapor of gasolene, the soap solution is indifferent to it, and vapor pressure is at an equilibrium throughout the system. The permanence of the mass in a closed vessel is therefore to be expected. In the open air it disintegrates rapidly, giving off gasolene vapor. The entrance of this material into drains and sewers where gasolene and soap are used for washing, as in garages and factories, is sufficient to account for the liberation of much combustible vapor and hence, perhaps, for explosions. Such material separates slowly and is difficult to trap.

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Contents

	PAGE
Storage in a Large Concrete Machine Shop	179
An Economical and Practical Cost System	189
Calculations Respecting Epicyclic Wheel Trains	194
Finishing Crank-pins and Piston Rods	195
Case-hardening the Alloy Steels	196
Small Furnace for Special Work	198
Making Wooden Rolls for Textile Machinery	200
Use of High-speed Steel	201
Casting Finished Bearings Accurately	201
Practical Letters from Our Readers: A Drilling Jig, a Milling Fixture and a Hand Broach....Pilots on Taps—Sizes of Tap Drills....Screw-slotting Jaws....More About Piston Pins....Hobbing a 25-degreee Worm Wheel with a 12½-degree Hob—Hobbing a Left-hand Worm Wheel with a Right-hand Hob....Making Some Sliding Yokes....Standardization of Drawing-room Methods....Lead as Pattern Material....Recutting Micrometer Screws	202-206
The Maximus Brake	207
Loss of Heat Due to Boiler Scale	207
Danger of Explosion from Gasolene and Soap	207
Metal Factory Equipment	208
The Course of Trade	208
The Lusitania	209
The Hobbing Process for Cutting Spur Gears	209
Henry W. Clarke	209
New Publications	209
New Tool and Machine Shop Appliances	210

Metal Factory Equipment

Our leading article deals with storage utilities of a fire-resisting form of construction, designed and made to be used in concrete steel machine-shop buildings. In that installation the prominent feature was apparently that of the fire-resisting qualities, and is a logical development for buildings so nearly fire-proof as concrete construction produces. While this feature is important, there are others which are hardly less valuable in metal machine-shop equipment and utilities.

The usual wooden devices and constructions for storing and transporting materials and tools, and wooden factory furniture in general, should be condemned. They easily and inevitably become oil soaked, thus are more inflammable and are a menace even in a wooden factory building. They are of necessity inelastic as far as individual sections are concerned from the very nature of their construction, and are thus not adaptable to a wide range of storage; but must be, considered broadly, in the nature of fixed bins, boxes and shelving made without adjustments. The reverse can be made true in a metal development.

Wooden parts and members are easily broken, injured or destroyed; often soon take on a dilapidated appearance, and when they are abandoned, even if their usefulness is not entirely gone, there is no reclaiming value. It is needless to point out the much greater durability of the metal construction and that old metals always have some value.

While the question of cost is dependent upon the design and market price of the materials used, the relative cost, taking into consideration the element of depreciation, cannot be so very unequal. Lumber is steadily advancing in value. The price of many grades is double today what it was ten years ago. Thus any disadvantage which the metal construction may be under today in point of cost, when compared with wooden construction, will undoubtedly lessen as time goes on, even as it has done in the past few years. That such a disadvantage exists at the present time we are not at all certain. We have knowledge of one large development of racks, which were estimated in both wood and metal, with the result that the wooden development figured $1.66 per cubic foot of effective storage volume, against $0.90 for the metal.

But little can be said in favor of the appearance of wooden construction over metal, and this little loses its effect before the broad principle that whatever performs all of its functions properly, is right, and it should look right.

There is no defense for the usual shop rack, bin and shelving, sketched out with a rough free-hand on the spur of the moment; built from whatever material happened to be nearest at hand, with no thought of strength or suitability of the various members, used because it was in existence and clearly an inefficient production. They are as unsatisfactory as are most makeshifts.

Of course, all wooden machine-shop utilities are not as bad as we have described. Yet the advantages of the metal are so varied that a broad condemnation is not too strong. The wooden construction should be discarded for at least new and replacing installations, if any elements of efficiency and durability are desired.

The devices which are described in the article referred to in our opening sentence show what can be done in producing such metal utilities and constitute a step forward in factory economy.

The Course of Trade

A recent number of the New York *Times* contained a valuable resumé of business conditions during the first half of 1907 as compared with those of the same half of 1906, which certainly show few signs of the business reaction which the pessimists are beginning to tell us to expect. In particular, except for the figures of this city, the bank clearings of the country showed an increase of 8.3 per cent.—a figure which, however, is changed to a decrease of 2.3 per cent. when the exchanges of this city are included. The smaller figures for New York are, however, undoubtedly due to the lessening of speculative activity on the stock exchange—a decrease which is represented by smaller transactions to the extent of over 33,000,000 shares. What is now looked upon as the best business barometer—the output of pig iron—showed an increase of over 1,000,000 tons, or 9.2 per cent., while the gross earnings of railroads increased $260,000,000, or 11.2 per cent.

The disquieting feature of the present situation is of course the crop prospects, which are not equal to those of last year because of the extreme lateness of the spring. The Government reports indicate a reduced product of wheat of 12 per cent. and of corn of 5 per cent.—the latter being by far the more important product. While, of course, this reduced output represents a lessened production of wealth in the abstract, it must be remembered that smaller crops are accompanied with higher prices, which, to some extent at least, maintain the purchasing power of the producers—the value of the expected crops at present prices being, in fact, in excess of the crops of last year at the prices then prevailing.

The *Times* has also collected the opinions of a large number of editors of trade journals which are uniformly optimistic, and in some cases enthusiastically so, regarding the outlook. It is especially significant that the editor of Dun's *Review* does not regard the stringency in money

markets as a serious matter, saying that "the monetary problem will gradually solve itself." The stringency of the money market is, in fact, looked upon as simply an index of the great activity in trade and, especially in view of the universal complaint of shortage of the supply of labor, the shortage of capital can scarcely be looked upon in any other way—the two phenomena springing, no doubt, from the same source.

The Hobbing Process for Cutting Spur Gears

The cutting of common spur gears by means of a hob tilted to the pitch angle and then fed across the blank while the two revolve in unison after the manner of worm-gear hobbing, has often been proposed and indeed practised to some extent. A machine for the application of this process was shown in the well remembered articles on "The Theory and Practice of the Teeth of Gears," published in these columns in 1890 from the pen of George B. Grant, and we have occasionally heard of these gears being made in this manner by means of extemporized apparatus. An American patent was, in fact, issued for a machine embodying the process in 1889.

It does not appear, however, that the method has ever been applied in a commercial way until recently. It has now been taken up in Germany, and also to a lesser extent in England. Just what measure of success has attended the new machines we are unable to determine, but we understand that they are being put out in considerable numbers, and that they are considered successful. The system is fundamentally a very attractive one, especially from the standpoint of the simplicity of the machines. Should the machines prove successful, they will supply another instance of the slowness with which fundamental ideas receive recognition in commercial machines, and a case which will be all the more remarkable because of the great amount of attention which has been devoted to gear cutting. There is scarcely a feature of machine-shop practice which has received more attention, and should this system of gear cutting turn out to be a success, it will furnish a remarkable illustration of the manner in which fundamental ideas sometimes lie dormant for many years.

The Lusitania

As we go to press we learn through the daily press that the official trial trip of the Lusitania has taken place, with highly satisfactory results, the average speed over a 300-mile course, which was covered four times, having been in excess of 25¼ knots, while the highest speed obtained was about 28 knots. This performance bears out the promise of the preliminary trial trip in which, under somewhat adverse conditions, a speed of 25 knots was obtained.

Our English exchanges are publishing extended descriptions of this magnificent ship, a recent number of *Engineering* containing two very striking half-tone illustrations of the ship when steaming at 25 knots, which indicate a very high efficiency in the matter of wave resistance, as shown by the wave line. The ship, we are told, "proved as free from vibration at all powers as had been anticipated and in every respect the performance of this great vessel bids fair to be all that has been anticipated." Our contemporary gives also a series of striking interior views which make plain the commodious nature of the passenger accommodations—a fact that is in a measure indicated by the hight between decks, which is 10½ feet.

The ship has a total length of 750 feet with a load draft of 37 feet 6 inches. Her turbine engines will have a capacity of 70,000 horse-power which is nearly 25,000 in excess of the next most powerful marine engines in existence—those of the "Kaiser Wilhelm II" of the North German Lloyd Line. The ship is to be practically exclusively for passenger traffic, the cargo space admitting only 600 tons of dead-weight cargo, while the total tonnage, by official measurement is 32,500. The carrying capacity comprises 550 first-class, 500 second-class, and more than 1200 third-class passengers, the officers and crew swelling the number of persons on board to over 3000. She is expected to leave Liverpool for New York early in September and the sister ship, the "Mauretania," will follow in about one month.

Henry W. Clarke

Henry W. Clarke, founder and senior member of the firm of Hill, Clarke & Co., Boston, Mass. died July 27, of old age, at his home in Watertown, a suburb of Boston, having passed his 85th year.

Born at Princeton, Mass., he started his business career at Boston in 1835, when 18 years old, entering the employ of Geo. H. Gray & Danforth, leading hardware dealers. In 1866 he joined the firm of Horace Mac Murtree & Co., engineers and machinery agents, which company, a few years later, was re-organized as Hill, Clarke & Co., becoming at that time the pioneer machinery merchants in the country.

Mr. Clarke continued in the active management of his company until about a year and a half ago. He leaves a widow, two sons, Chas. A. Clarke, present president of the company, and Dr. Frank W. Clarke of the Government Geological Survey, and one daughter, Miss Abby Clarke.

New Publications

A Course in Structural Drafting. By W. C. Browning. 64 6x9-in. pages, with numerous text cuts and 12 folded plates. The Industrial Magazine, Collinwood, O. Price $1.

Of the numerous manuals of drawing we have seen none more useful than this. It is distinctly a single-purpose book and it sticks to its text in admirable manner. It is not in any sense a treatise on design, but a draftsman's book, pure and simple. The leading conventions employed in structural drafting, of which there are many given with great fullness and just how structural drawings ought to look is shown clearly and fully. The folded plates are fac-simile reproductions, as they should be in a work of this kind. Any draftsman who contemplates taking up structural work will find it of decided value, and the draftsman who has an occasional structural drawing to execute will also find it well worth its price.

Water Proofing. Vol. 1. No. 1. Monthly, price $1. M. H. Lewis, 8-10 Burling Slip, New York.

The water-proofing industry has made great strides in the past ten years, keeping pace with the increase in the magnitude of deep foundation and other sub surface work, and with a better understanding of the interior effects of dampness upon the life of structures and the health of occupants. Perhaps the best indication of this growth is the appearance of this new periodical devoted especially to it, of which we have before us the introductory number. The paper appeals, of course, chiefly to civil engineers and architects. While small, it is a serious publication, cultivating no fads and riding no hobbies. The contents of the first number and a list of forthcoming articles which appear in it, indicate that it has a much larger field than most persons would imagine.

Statistics show a very healthy growth of the Canadian iron and steel industries, the value of the output having grown from $481,000,000 in 1901 to $712,000,000 in 1906. The greatest absolute, though not the greatest relative increase, has taken place in Ontario. In Sydney, N. S., the increase during this interval has been over six to one. The production of iron and steel in Canada is subject to a government bounty, which now amounts to over a million and a half dollars per annum.

Small risers on manganese-bronze castings are a detriment rather than of value, as they draw the metal from the casting instead of feeding it. Large risers are absolutely necessary for the successful casting of manganese-bronze.—*The Brass World.*

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

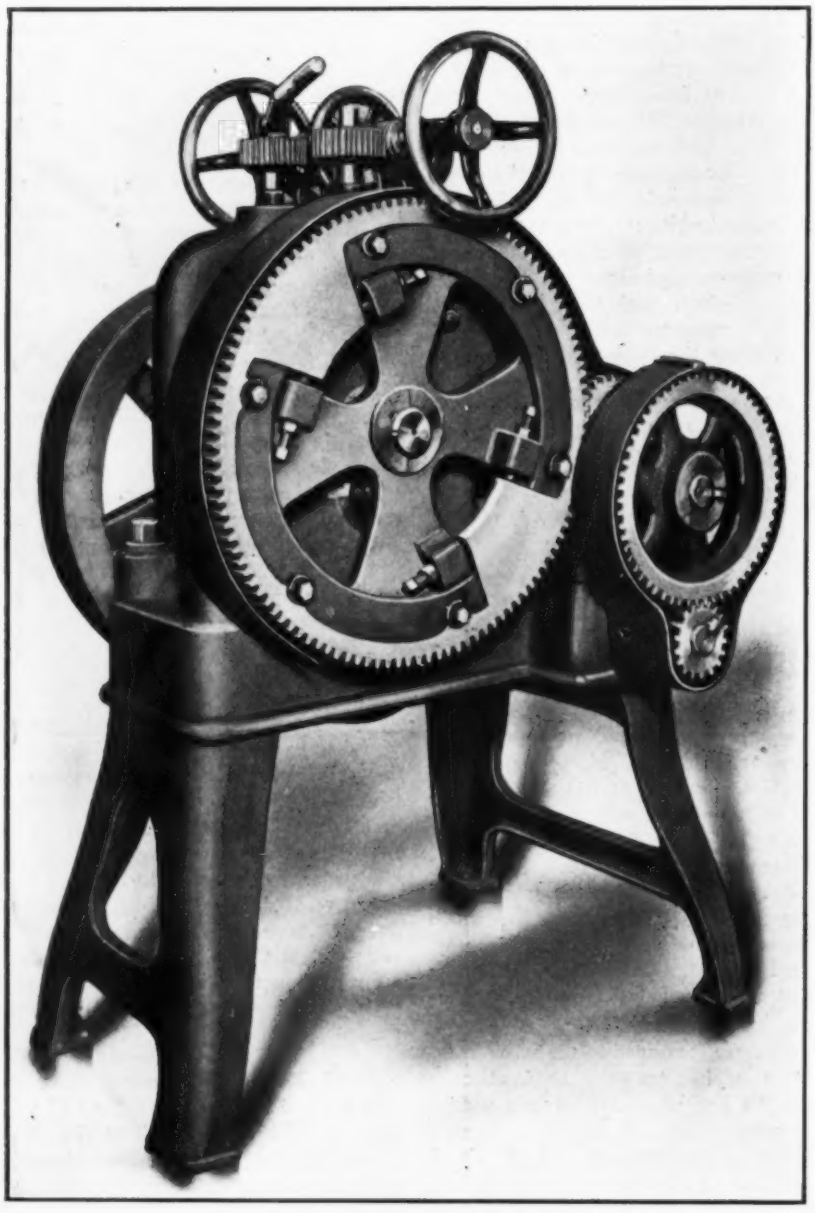
A Spoon Grading Mill

The accompanying illustration shows a new spoon grading mill manufactured by the Standard Machinery Company, of Providence, Rhode Island.

While it is of direct use to makers of silverware and jewelry, some of the mechanical features are of more general interest. In the manufacture of spoon blanks it is essential that the dies which are set in the rolls should be in perfect alinement. As the lower roll of the machine is positively located the adjustment must be in the upper one. This feature is embodied in the large gear shown on the side of the machine. This gear has two members; the rim in which the teeth are cut and the spider which carries it. Two lugs project inward from the rim against each of which bear two screws, one on either side. These screws are in bosses of the spider.

Adjustments of the gears with reference to the large gear spider and thus with reference to its roll and thus of the rolls with each other are made by these fine pitched screws. Each screw is provided with a check-nut to lock it in position.

The size of machine illustrated is listed as No. 1.



A SPOON GRADING MILL

Milling-machine Attachments

Those who are not familiar with the various attachments supplied for milling machines and used in special classes of work have missed some of its possibilities in tool-room or similar work. Most of the attachments one sees in shops are built in the shop to suit shop needs, and are often very limited in capacity or adaptability or both. There is no reason why a vertical attachment should not swivel to any angle. Some attachments are made too light or not well supported, and this shows both in the quality of the work they turn out.

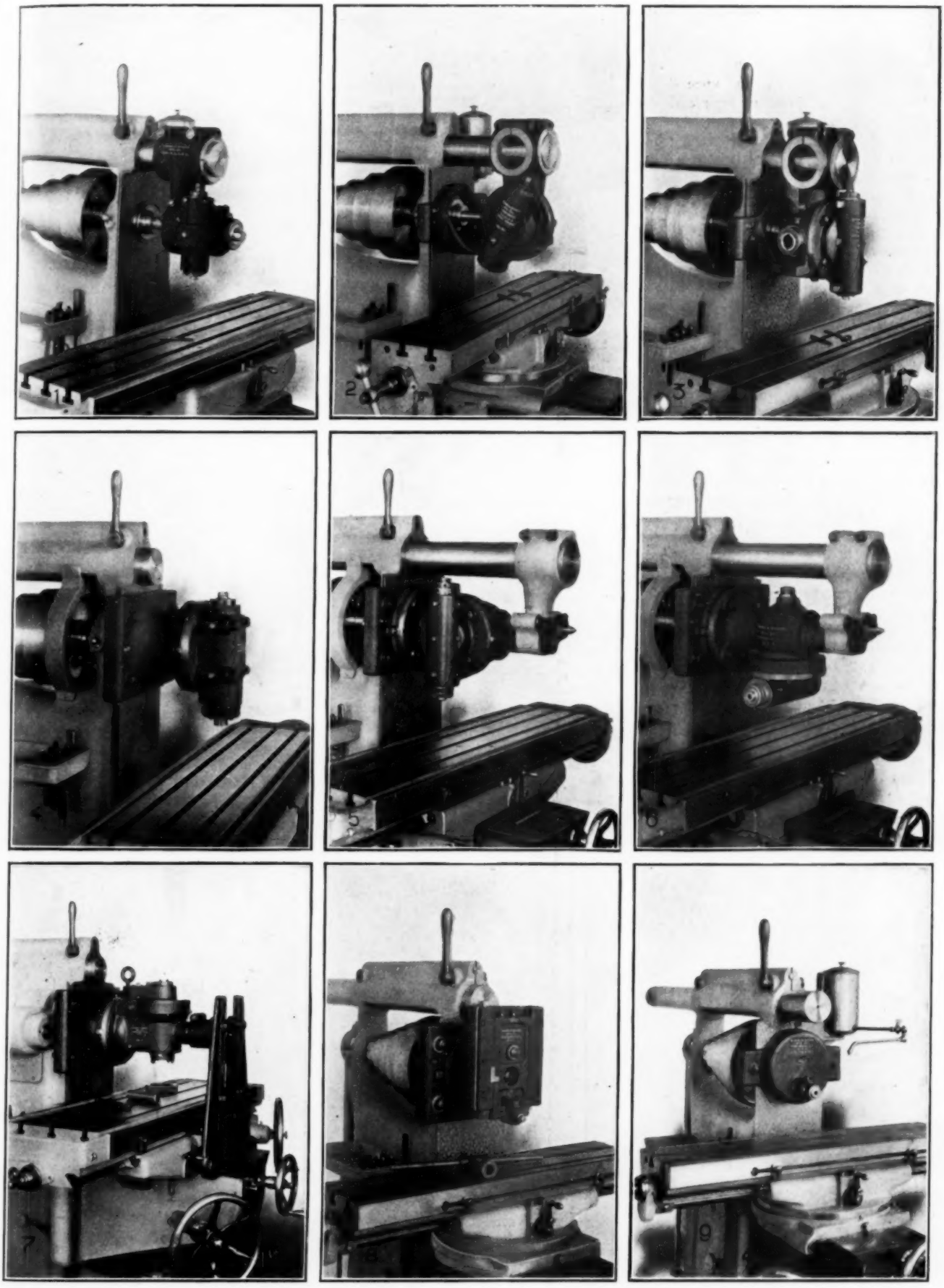
The Brown & Sharpe Manufacturing Company, Providence, R. I., has re-designed its whole line of milling-machine attachments so that nearly all of them are now clamped to the knee slide on the column of the machines, this having been extended in their new machines. This insures a rigidity which it is not possible to obtain in the older design.

The only exception to this is the light vertical-spindle attachment shown in Fig. 1; in this case the long bearing on the arm gives all the support needed. The horizontal shaft is inserted in the spindle of the machine and the vertical spindle driven by a worm and wheel. The milling spindle can be set at any angle from the vertical to a horizontal position, graduations being provided on the base of the spindle head to indicate the angle.

Figs. 2 and 3 show the compound vertical-spindle milling attachments in two positions. In the first the spindle swings to or from the head, and in Fig. 3 it is turned at right angles on the arm so that the spindle swings the other way. The same graduations are used in each case by this means, simplifying the construction very materially.

The spindle is driven through bevel steel gears by the horizontal shaft in the main spindle. This allows the spindle to be set at any angle without interfering with the driving in the least.

Another vertical-spindle attachment, which is very rigid owing to its broad bearing on the knee slide, is shown in Fig. 4. The swinging of the head is around the driving shaft, and the amount



NEW ATTACHMENTS FOR THE BROWN & SHARPE MILLING MACHINE

is indicated by the graduations shown. The four bolts clamp it rigidly in position.

Figs. 5 and 6 show a universal milling attachment in both vertical and horizontal positions. This clamps to the knee slide and is also supported at the outer end by the overhanging arm. As it swings in both directions, any desired angle can be obtained, no matter whether it is in either a vertical or a horizontal plane or anywhere between the two. Both movements are graduated independently, and the drive is through bevel gears, as with the others.

A vertical-spindle attachment for heavy work is shown in Fig. 7. This is not only clamped to the knee slide, but the outer end is rigidly supported by braces clamped to the regular arm support, so that quite large face mills can be used to advantage in this way. It is adjustable in the direction shown and an indexed dial is provided.

The slotting attachment is entirely new in design and well adapted for toolmaking, die centering and work of this kind. The details of construction are shown in Fig. 12, the parts being few in number and well proportioned. This is entirely independent of the arm, being clamped rigidly to the face of the column.

The main spindle drives the tool slide through an adjustable crank, so that different strokes can be had at will and can be indicated by the graduated scale. It can be swiveled entirely around the spindle as a center and set at any angle from the vertical to the horizontal position, the setting being indicated by graduations reading to ½ degree on the side of the swivel head. This attachment is entirely self contained, and no auxiliary belting is required for mounting it on the machine.

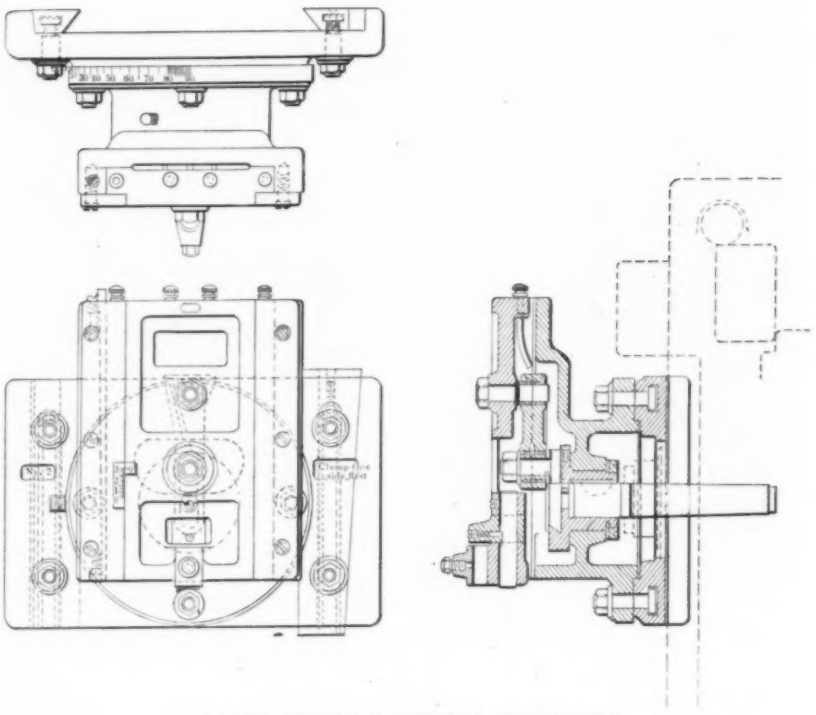
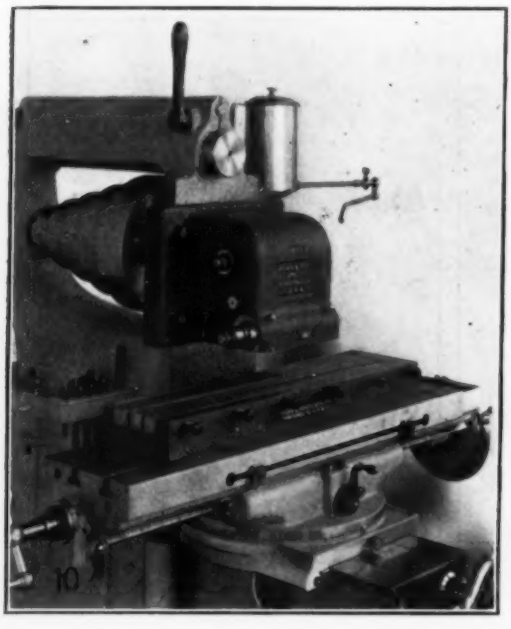


FIG. 12. DETAILS OF SLOTTING ATTACHMENT

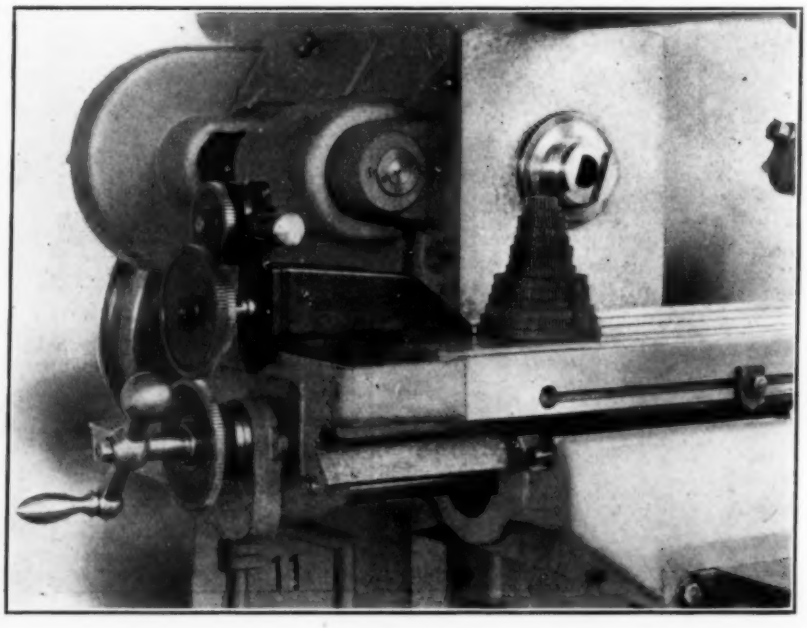
The method of allowing for variation in the width of machine faces is to move the adjustable gib on the right-hand side, adjusted by the screw *A*, which moves it horizontally. When made to accommodate any particular machine, the chuck screw *B* is set up and the attachment can then be put on or taken off without further adjustment.

Fig. 10 shows the new rack-cutting attachment which is supported both from the column and the overhang arm. All working parts are entirely inclosed, thus protecting them from dirt and injury. The cutter spindle is hardened and ground and runs in bronze boxes, compensation for wear being provided in the front box. It is driven from the main spindle through hardened bevel and spur gears. Vises are furnished for holding the racks.

An indexing attachment for rack cutting is shown in Fig. 11. In this the bracket which attaches to the table carries a locking disk, together with change gears for gearing to the feed screw. With this attachment the racks can be cut and longitudinal settings made without relying on the dial ordinarily used. The locking has a slot for the locking pin. Change gears are furnished for various pitches, either English or metric.



RACK-CUTTING ATTACHMENT



SPACING DEVICE FOR RACK CUTTING

A Thread-milling Attachment for Engine Lathes

We illustrate an attachment which may be applied to any standard engine lathe, with about the same amount of effort as required for putting in place a steady rest, and which permits of milling any thread within the capacity of the lathe, relieving, when desired, being also provided for.

The principal parts of the device are the cutter-head *A*, Fig. 3, which is clamped in the T-slot of the lathe carriage rest in the same manner as a tool post; a so-called hood casting *B*, which is clamped, close to the headstock, to the ways of the lathe by bolt and clamp cross-tree; and an arm *C* bolted to the hood casting and forming the bearings for the telescoping driving shaft. The work, instead of being driven directly from the headstock as usual, is driven through the intermediary of the driving shaft of the attachment, the lathe back gears being thrown out, and moreover the nut in the large gear on the spindle being disengaged. The pulley *D* on the driving shaft is driven by the cone pinion of the lathe, as clearly shown in Fig. 2, and the motion is transmitted from the shaft to a geared face-plate, threaded to the nose of the lathe spindle, by means of a worm and worm wheel in the case *E*, Fig. 3, and bevel gears *F*. The arm *C* is further supported by an adjustable support from the head of the lathe, seen in Figs. 1 and 3. Provision is made for changing the rotative speed of the work by the changing of the pinion which meshes with the face-plate gear.

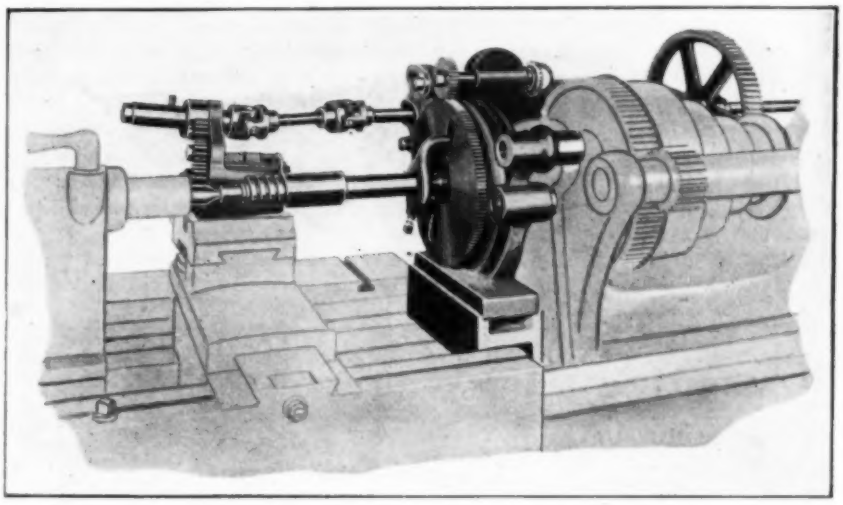


FIG. 4. REAR VIEW, WITHOUT RELIEVING ATTACHMENT

The cutter-head is adjustable to any angle corresponding to the pitch of thread desired, either right- or left-hand, and the center line of the cutter is always on a level with the center line of the work. The drive for the cutter is taken from the main driving shaft of the attachment by the universal-jointed shaft *G*, which permits of the swiveling of the cutter-head already referred to. A train of spur gears completes the transmission. To permit of the travel of the lathe carriage, the main driving shaft telescopes in the arm, lathes of any length being suited by extra lengths of driving shaft, each of which has a male

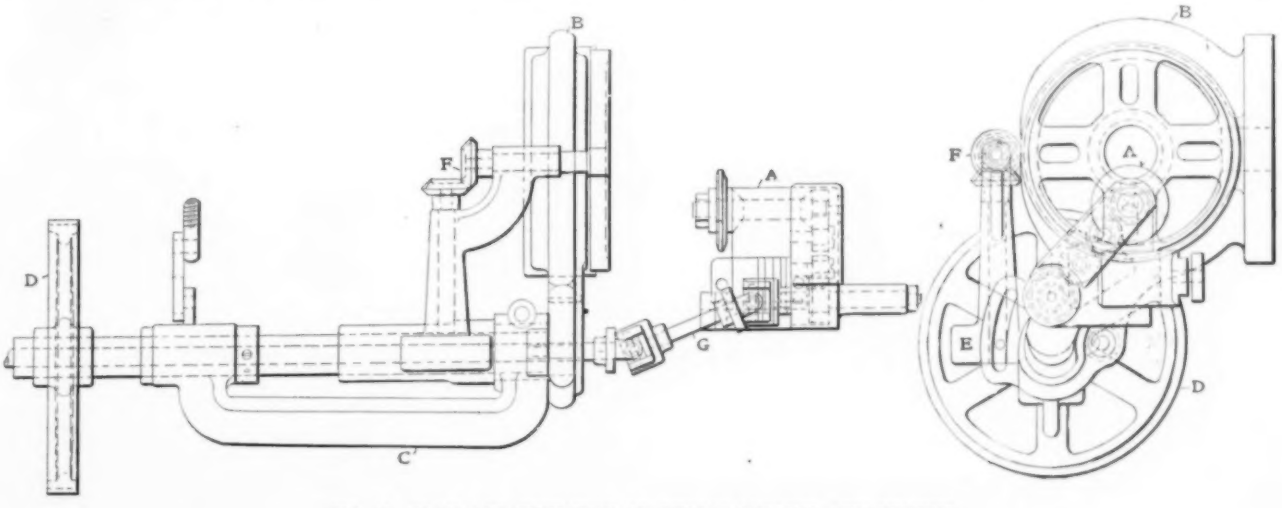


FIG. 3. PLAN AND ELEVATION OF THREAD-MILLING ATTACHMENT

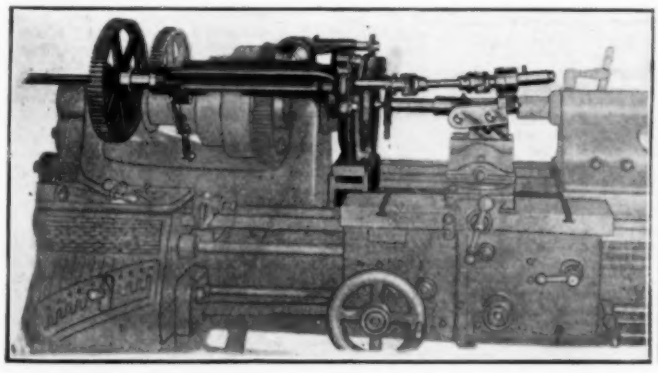


FIG. 1. FRONT VIEW, WITHOUT RELIEVING ATTACHMENT

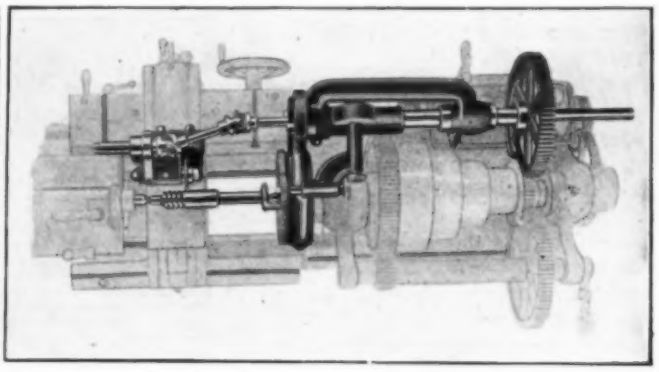


FIG. 2. TOP VIEW, WITHOUT RELIEVING ATTACHMENT

and female threaded end, the main driving shaft having a female threaded end to receive these pieces. The adjustment for depth of thread is determined by the micrometer head of the cross-feed screw of the lathe carriage. The travel of the carriage for varying screw pitches is regulated in the usual manner by change gears or by a quick-change gear box. Taper threads may be made on lathes fitted with taper attachments; multiple threads may also be made by using the proper cutter and lead. Cutters may be obtained of either carbon or high-speed steel, and are of the same type as the ordinary milling cutter, and are shaped according to the thread desired.

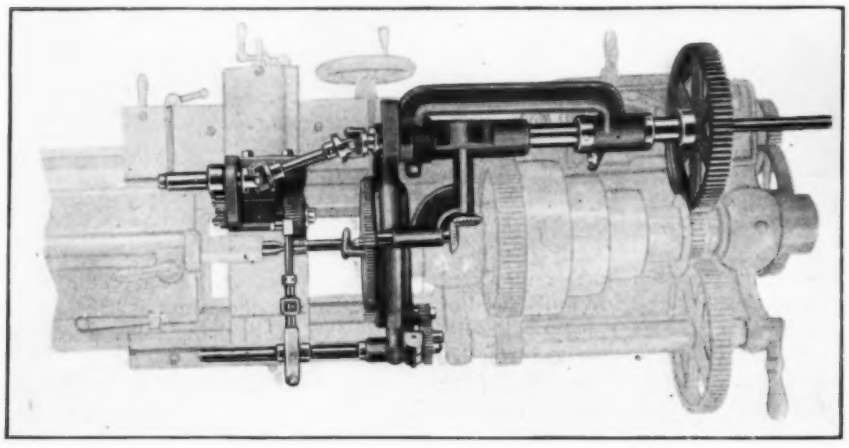


FIG. 5. TOP VIEW WITH RELIEVING ATTACHMENT

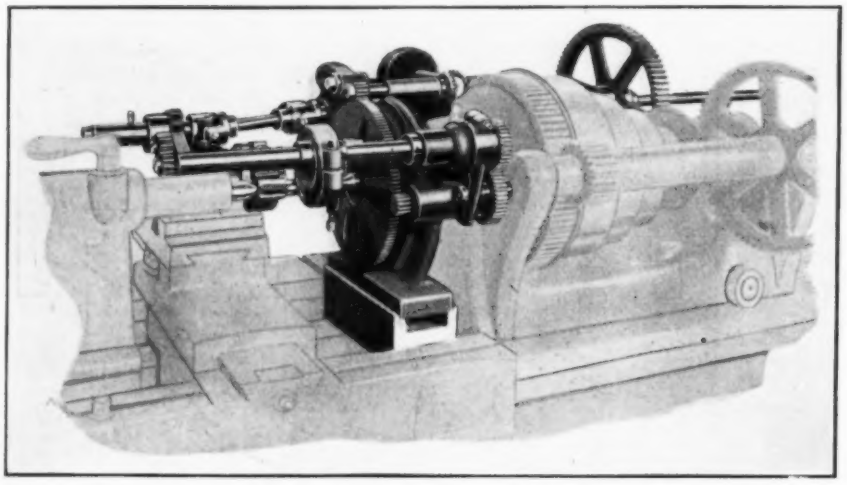


FIG. 6. REAR VIEW WITH RELIEVING ATTACHMENT

The Relieving Attachment

A useful auxiliary is the relieving attachment which may be ordered with the apparatus or obtained later, if this contingency be mentioned at the time of the first order. As shown in Figs. 5 and 6 this is attached at the back of the hood casting and is driven from the face-plate gear, through spur gearing, operating an eccentric best seen in Fig. 6, which by means of an adjustable rod works a rocker arm, causing the cutter arbor bearing to move back and forth in an eccentric bushing. The number of reliefs per revolution is controlled by the gears driving the relieving shaft, and the amount of the relief may be changed by changing the eccentric. Gang cutters, as illustrated, may be obtained for the ordinary tap length of thread, whereby the entire thread on a tap may be milled and relieved in one revolution of the work.

This attachment is furnished by Barwood & Snider, The Bourse, Philadelphia, Penn., for any swing standard make engine lathe from 18 inches up.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper list free. E. G. Smith Co., Columbia, Pa.

Let us quote you on gear cutting. Iroquois Machine Co., Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

We desire a few more machines or specialties to manufacture. Box 423, Troy, N. Y.

Machines designed and built. Walter S. McKinney, M. E., Broadway, Flushing, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

We will do your manufacturing for you; well established and equipped foundry and machine shop. Emmert Mfg. Co., Waynesboro, Penn.

Well established concern will pay royalty for several good patented machines or tools to manufacture. Emmert Mfg. Co., Waynesboro, Penn.

A well equipped machine shop in New England of sufficient capacity to employ 200 men is in a position to take on more work. Box 186, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Men who operate grinding machines should read H. Darbyshire's "Precision Grinding," a $2 book that's worth ten times that money to you. Hill Pub. Co., 505 Pearl St., New York.

An up to date modern foundry equipped to make large work, would like to get in touch with machinery builders who are in need of heavy gray iron castings; low freight rate to all eastern points. Address Box 242, AM. M.

Wanted—Agency for a good line of engines and pumps for irrigation work Pacific Coast States (last year's sales $100,000), send circulars, and letter stating what territory you can give exclusive rights in. Box 268, AM. M.

A well equipped machine shop and foundry desires to add to its output by the manufacture of articles of brass and iron which would find a ready sale in the south; correspondence invited. Box 122, AMER. MACH.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

The Forest City Specialty Mfg. Co., of Rockford, Illinois, would like to receive catalogs from machine tool manufacturers and dealers; also catalogs of machine shop equipment and supplies in order to complete their catalog file.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers, 146 West 56th Street.

Planer hands—C. Ashley, a planer hand, has written a book "Planer Kinks," for practical planer men and every planer hand should get it; $1 postpaid. Hill Pub. Co., 505 Pearl St., New York.

Salesmen, a paying side-line for you. We will allow a liberal commission for selling a new automatic hose-coupling of exceptional merit which we are placing on the market. This is a rare opportunity to substantially increase your income. Thos. H. Dallett Co., 23d and York, Philadelphia.

We have a special proposition for a few bright, energetic mechanics, such as foremen, draftsmen or machinists in different sections of the country; no canvassing or selling of any kind, and, while not interfering with your regular work, pays well for the time taken; we want only practical men who can be depended on to give the little time required, each week; further particulars on application. Box 102, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—A position by thorough factory systematizer with six years' experience in automobile business; installing systems and as head of production, receiving and stock departments. Address reply to J. J. C., AM. M.

ILLINOIS

Experienced designer wishes to change; now chief engineer of prominent engine manufacturer; position as manager or superintendent with financial interest desired. Box 259, AMERICAN MACHINIST.

INDIANA

Cost accountant; position by an experienced cost accountant, familiar with the best factory methods, the premium system used as an adjunct to the cost. Box 254, AM. MACH.

MASSACHUSETTS

A first-class mechanical engineer who during 1889 to 1891 equipped the factory of the Mergenthaler Linotype Co. with special tools and methods enabling this concern to build 60 linotypes per month, and who during 1899 to 1905 developed ideas of Mergenthaler on logotype machines and invented many new things thereto, all of which were, or are being patented and were sold for a fortune, desires a position; now employed; desires to leave east on account of ill health in family. Box 269, AMERICAN MACHINIST.

NEW YORK

Practical draftsman wants position near New York or Philadelphia. Box 263, AM. M.

A first-class pattern-maker, young and of good habits, with wide experience would like a position as foreman; references given. Box 255, AMERICAN MACHINIST.

Wanted—Position as superintendent, assistant superintendent or mechanical engineer by college graduate with experience; references. Box 265, AMERICAN MACHINIST.

A young tool and diemaker, 16 years' experience on tools, dies and experimental work, have also held position as inspector, would accept any position of trust. Box 258, AMERICAN MACHINIST.

Superintendent of machine works seeks position; has had extensive experience on medium and light work and can handle men to best advantage; highest references as to ability. Box 267, AMERICAN MACHINIST.

Foreman of toolmaking department of a large manufacturing company; thoroughly experienced in designing and building jigs, fixtures and special tools for manufacturing high grade interchangeable work, systematic, executive ability; can produce best results; desires position as assistant superintendent or foreman; location immaterial; references. Address Box 234, AMERICAN MACHINIST.

I am a foreman pattern maker with fourteen years' experience in all classes of pattern work, five years' as foundry assistant superintendent; my determination to advance more rapidly than possible where now located has prompted this inquiry; I feel I can convince you of my executive ability, tact and energy; am thirty years old and greatly desire to connect myself with a good live company, who will give me the opportunity to apply my every effort to their interest and recognize merit when shown. Address Box 257, AMERICAN MACHINIST.

PENNSYLVANIA

Master mechanic desires change as superintendent, assistant superintendent or mechanical engineer. Technical graduate, draftsman and designer, successful manager of men and organizer; good references. Box 184, AMERICAN MACHINIST.

Commercial engineer; a thorough business man with technical training desires an executive position in the business end of a manufacturing concern; experienced and has "made good"; best of references; details of experience on request. "Commercial," AM. M.

Wanted—Position as advertising manager with manufacturing concern, preferably in mechanical field, by a woman with years of experience in that capacity and field, with large, representative houses; thoroughly competent to handle printing, illustrating and the preparation of copy; at present employed; reasons for seeking change made known to prospective employer. Box 103, AMERICAN MACHINIST.

RHODE ISLAND

General superintendent solicits correspondence from companies desiring the services of a practical mechanic and executive; highest references. Box 233, AMER. MACH.

VERMONT

Cost accountant, thirty, 7 years' office, 3 shop, experience desires change; can install complete office and shop system; salary $1500. Box 270, AMERICAN MACHINIST.

WISCONSIN

First-class practical designer and mechanic; wide experience high-grade automatic machinery and tools; New York city or vicinity; at liberty Sept. 1. Box 262, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Toolmakers experienced on fixtures, dies and gages. Address with full particulars as to experience, wages required, giving definite time as to commencing work. Ross Rifle Company, Quebec, Canada.

CONNECTICUT

Wanted—First-class all-around machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Wanted—A competent draftsman for general mill work, must have some experience in piping and hydraulic work and be able to detail design from general instructions; technical man preferred. Box 264, AMER. MACH.

Tool and die makers wanted; a number of first-class die makers on punching, bending and blanking dies for sheet-brass and steel work; also toolmakers, especially on cutting tools, such as millers, reamers, taps, etc.; steady employment for the right parties. Apply at once to The Yale & Towne Mfg. Company, Stamford, Conn.

ILLINOIS

Wanted—First-class salesman for high speed tools; must be practical man, capable of demonstrating tools in shops, factories etc. Box 210, AMERICAN MACHINIST.

Wanted—Technical graduate, with from five to ten years' practical experience, to design and develop intricate and automatic machinery; only those of the highest grade will be considered; position is permanent to the man who can make good; firm is established and growing; in replying, state age, nationality, salary expected, state whether married or single, and also give references; correspondence confidential. Box 266, AM. MACH.

INDIANA

Wanted—Five good toolmakers and six lathe men; good wages; steady employment. The Western Motor Co., Logansport, Ind.

MISSOURI

General manager wanted by company manufacturing light machinery, has fine equipment and good business; salary commensurate with ability; it is desired that he take about $5000 interest in company; communications held confidential. Box 244, AM. M.

NEW JERSEY

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—Mechanical draftsman on small tool and jig work; one experienced in laying out cams for Brown & Sharpe automatic screw machine preferred; state age, experience, and wages expected. Box 241, AM. M.

Machinist, toolmaker; one posted on screw machine and press work, to assist in running small department manufacturing brass instruments; good prospects for right man; steady Newark job. Box 261, AMER. MACH.

NEW YORK

Wanted—First-class toolmakers on tools, jigs, and fixtures. Boxes 7 and 8, Syracuse, N. Y.

Salesman—First-class man to sell engines and boilers; wish to hear from those who wish to advance themselves, and good position open to right party. Address J. K. D., AMERICAN MACHINIST.

Toolmaker; a first-class practical toolmaker, familiar with all kinds of tool work and shop practice; experienced in handling men; a good position for the right man; write, stating age, experience both as a mechanic and in handling men, and salary expected. Address "Tools," 41 W. 34th St., New York.

Wanted—General foreman for machine shop employing 75 to 100 men, building machine tools, special machinery, etc.; must be thorough mechanic, with tact, resource and push; capable and familiar with handling men and work to best advantage; good opportunity and future for competent man, with rapidly growing business. Address with full particulars as to experience, age, references, etc. Box 256, AMERICAN MACHINIST.

Machinists for lathes, planers and floor work wanted; day and night shift; we are increasing our force and offer here an excellent opportunity for energetic mechanics who have determination to forge ahead; the future advancement of all our employees depends entirely upon their capabilities and energy; we recognize merit as fast as the opportunity offers; when applying state wages desired. Apply Ingersoll-Rand Co., Painted Post, N. Y.

OHIO

Wanted—Experienced punch and shear draftsman; state qualifications, age, and salary expected. Box 70, AMER. MACHINIST.

Wanted—Operator for Jones & Lamson latest type machine; state age, experience and wages. Address Box 243, AMER. MACHINIST.

Wanted—Several draftsmen familiar with steam hammer designing; state age, experience, and salary expected. Box 71, AM. M.

To a live young, practical foundry foreman, we will pay $100 per month and 10 per cent. of the profits payable weekly; capacity 25 tons per day, 10 molding machines, besides heavy floor work. Address Box 232, AM. M.

Wanted—Machinists and operatives; we are about to remove our machine shops from Kent, Ohio, to Franklin, Pa. Some of our present employees own their homes in Ohio and do not wish to leave them so are seeking other permanent employment here. We therefore offer to qualified persons positions in our present plant from now until about October first and permanent positions to those who then move with the plant to Franklin, Pa. To such persons who accept service with us under the present conditions, we will guarantee the best permanent positions when our Franklin plant is in operation, giving the preference even over present residents of Franklin. Franklin is a beautiful little city of 12,000 inhabitants with excellent schools and other facilities. We have no labor troubles in our shops nor have we ever had any. Address communications to C. L. Winey, Works Manager, Kent, Ohio.

PENNSYLVANIA

Wanted—Lathe, planer and boring mill hands. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Foreman for gear cutting department; must have experience; apply with particulars to R. D. Nuttall Co., Pittsburg, Pa.

Technical graduate to teach machine design and mechanical drawing; location Western Pennsylvania; salary $1200 per year. Box 231, AMERICAN MACHINIST.

Wanted—Several good tool and die makers at once; also men who have had experience in experimental work on typewriters, adding machines, etc. The Adder Machine Co., Wilkes-Barre, Pa.

Foundry foreman wanted for small jobbing foundry employing 30 molders; one experienced with molding machines preferred; a good opportunity for the right man; town of about 18,000 inhabitants. Address "Keystone," care AMERICAN MACHINIST.

We are just completing the fitting up of a modern machine manufacturing plant, and invite applications for employment from machinists, pattern makers and molders; steady employment and good wages for reliable and desirable workmen; when writing give full details of experience. The Shepherd Engineering Co., Williamsport, Pa.

Machinist—Wanted a man who thoroughly understands running of double stroke headers. We have a well paying permanent position for the right man; none need apply who have not had considerable experience with leading manufacturers using the double stroke headers. Apply by mail in strictest confidence to Metallic Specialty Mfg. Co., No. 1616-1628 No. 21st St., Philadelphia, Pa.

First-class molder with experience on medium weight high grade iron machinery castings; to the right man if familiar with melting iron, and with ability to handle men, position of assistant foreman is open; to receive consideration give full details of experience, for whom you have worked, length of time, class of work, and wages received. All communications will be considered confidential. Box 217, AMERICAN MACHINIST.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery; good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

VIRGINIA

Wanted—Two or three first-class draftsmen, those familiar with steam shovel and dredge designs preferred; give full experience and salary expected. Box 882, Richmond, Va.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

For Sale

A good 20 h.p. return tubular boiler. Pittenger Roof Paint Co., Elyria, O.

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, O.

For Sale—United States patent automatic drill chuck, for drill press, the greatest time saver of the day. Address Ed. Blaess, care Henry F. Setzler, Fremont, O.

For Sale—Ten volume library covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

One 10x10x12 duplex steam pump; one 10x14x12 Rand air compressor; one No. 3 Toledo punch press; two hydraulic presses, will take in material 35"x35". Shartle Brothers, Middletown, O.

For Sale—Gas engines, 38 h.p. Backus with electric and tube igniter, batteries, equalizer and self-starter; 40 h.p. Foos with 30 kw. 240 V. Diehl generator for 3 wire system and transformer, also 75 h.p. suction gas producer. Address Box 260, AMERICAN MACHINIST.

For Sale—One 12"x16" center crank automatic engine in good condition; diameter of crank shaft 4⅞"; size of driving wheel 40"x15"; size of governor wheel 58"x13"; Bay State Iron Works make; only reason for replacing it was increase in power plant. Erie Foundry Company, Erie, Pa.

For Sale—Sets of patterns for pulley turning and boring lathe, sizes 30", 42" and 60", with detail working drawing, and with some special boring bars and tools; these patterns were originally purchased from M. C. Hendley, Indianapolis, Ind.; a bargain for anyone who wishes to take up this line of goods to manufacture them; price $3000. Goldens Foundry & Machine Co., Columbus, Ga.

Alphabetical Index to Advertisers

	PAGE
Abrasive Material Co	78
Acme Machinery Co	38
Adams Co	63
Almond Mfg. Co., T. R	76
Alteneder & Sons, Theo	38
American Blower Co	79
American Emery Wheel Wks.	78
American Gas Furnace Co	25
American Pulley Co	69
American Tool Works Co. 8 and	94
American Tube & Stamp'g Co.	99
Armstrong-Blum Mfg. Co	71
Armstrong Bros. Tool Co	64
Armstrong College	71
Athol Machine Co	75
Automatic Machine Co	93
Baird Machine Co	74
Baker Bros	63
Baldwin Chain & Mfg. Co	93
Baldwin Steel Co	47
Barnes Co., B. F	68
Barnes Co., W. F. & John	14
Barnett Co., G. & H...4th cover	
Bartlett, E. E	92
Baush Mach. Tool Co...3d cover	
Bay State Stamping Co	75
Beaman & Smith Co...15 and	76
Becker-Brainard Milling Machine Co	23
Bemis & Call Hardw. & Tool Co	69
Besly & Co., Chas. H	97
Bethlehem Steel Co	51
Betts Machine Co	6
Bickford Drill & Tool Co	10
Bignall & Keeler Co	70
Bilgram, Hugo	38
Billings & Spencer Co	62
Binsse Mach. Co	38
Birdsboro Steel Fdry. & Machine Co	63
Blaisdell Machinery Co	86
Blanchard Machine Co	66
Bliss Co., E. W	25
Blount Co., J. G	32
Boker & Co., Hermann	59
Boston Gear Works	80
Box & Co., Alfred	88
Boynton & Plummer	93
Bradford Machine Tool Co	5
Bradley & Son, C. C	68
Bridgeport Safety Emery Wheel Co	78
Bristol Co...4th cover	
Bristol, Wm. H	38
Brown & Co., R. H	77
Brown Engine Works, C. H.	99
Brown Hoisting Machry. Co.	89
Brown & Sharpe Mfg. Co. 45 and	4th cover
Brubaker & Bros., W. L	70
Buffalo Forge Co...4th cover	
Bullard Mach. Tool Co. 37 and	94
Burke Electric Co	84
Burke Machinery Co	69
Burroughs Co., Chas	24
Burr & Sons, John T	71
Butterfield & Co	98
Caldwell & Son Co., H. W...101	
Carborundum Co	21
Card Mfg. Co., S. W	16
Carpenter Tap & Die Co., J. M	66
Carver File Co	70
Case Mfg. Co	88
C & C Electric Co	82
Chambersburg Engineering Co.	99
Champion Tool Works Co	93
Chesterman & Co., Ltd., Jas.	97
Chicago Flexible Shaft Co	62
Chicago Pneu. Tool Co	86
Chicago Rawhide Mfg. Co	81
Cincinnati Electrical Tool Co.	26
Cincinnati Machine Tool Co.	100
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co	9
Cincinnati Shaper Co	102
Clark Auto. Telephone Switchboard Co	93
Clark Cast Steel Cement Co.	74
Clark, Jr. & Co., Jas	79
Cleveland Auto. Mach. Co	18
Cleveland Cap Screw Co	74
Cleveland Crane & Car Co	88
Cleveland Planer Works	93
Cleveland Twist Drill Co. 4th cover	
Cleveland Wire Spring Co	68
Clough, R. M	93
Coates Clipper Mfg. Co	69
Coes Wrench Co	33
Colburn Machine Tool Co	26
Cook Co., Asa S	70
Crescent Forgings Co	62
Crocker-Wheeler Co	82
Crosby Steam Gage & Valve Co	17
Cumberland Steel Co	71
Curtis & Co. Mfg. Co	88
Curtis & Curtis Co	70
Cushman Chuck Co	76
Dallett Co., Thos. H	27
Davis, Rodney	81
Desmond-Stephan Mfg. Co	78
Detrick & Harvey Mach. Co.	66
Diamond Chain & Mfg. Co	71
Diehl Mfg. Co	84
Dill Slotter People	66
Dixon Crucible Co., Joseph	90
Dodge & Day	70
Dreses Machine Tool Co	61
Druckleib, C	87
Dyson & Sons, Jos	20
Earle Gear & Mach. Co	81
Eastern Machinery Co	88
Eberhardt Bros. Mach. Co	86
Electric Controller & Supply Co	83
Elmes Engineering Works, Chas. F	92
Emmert Mfg. Co	75
Errington, F. A	77
Evans Friction Cone Co	70
Excelsior Needle Co	69
Fairbanks Co	66
Farrel Fdry. & Mach. Co	74
Fawcus Machine Co	80
Fellows Gear Shaper Co	81
Firth-Sterling Steel Co	73
Fitchburg Machine Works	31
Foote-Burt Co., The	98
Fosdick Machine Tool Co	16
Franklin Mfg. Co., H. H	64
Freyer Machinery Co	88
Gang Co., Wm. E	71
Gardner Machine Co	78
General Electric Co	82
General Pneumatic Tool Co.	89
Geometric Tool Co	21
Gisholt Mach. Co	1
Gleason Works...4th cover	
Globe Machine & Stamping Co	74
Goldschmidt Thermit Co	91
Goodell Pratt Co	98
Gorton Machine Co., Geo	92
Gould & Eberhardt	27
Graham Mfg. Co	75
Grant Gear Works	80
Grant Mfg. & Mach. Co	92
Gray Co., G. A	38
Gray & Prior Machine Co	66
Greaves, Klusman & Co	69
Hammacher, Schlemmer & Co.	51
Hanna Engineering Works	70
Hardinge Bros	71
Harrington, Son & Co., Edw.	89
Harrison & Knight Mfg. Co.	70
Hart & Cooley Co	26
Hart Mfg. Co	68
Heller Bros. Co	72
Hendey Machine Co	53
Henley Publishing Co., N. W.	25
Henry & Wright Mfg. Co...101	
Hill, Clarke & Co., Inc	95
Hill Publishing Co...38 and	60
Hisey-Wolf Machine Co	20
Hoefer Mfg. Co	17
Hoggson & Pettis Mfg. Co.	76
Hopkinson Machine Works	75
Horsburgh & Scott Co...4th cover	
Horton & Son Co., E	76
Hunt & Co., Robt. W	71
Hurlbut-Rogers Machine Co.	93
Hyatt Roller Bearing Co	71
Independent Pneumatic Tool Co	71
Industrial Oxygen Co	74
Ingersoll-Rand Co	87
Ingersoll Milling Mach. Co.	67
International Specialty Co	78
Iroquois Machine Co	81
Jacobs Mfg. Co	77
Jacobson Mach. Mfg. Co	90
Jantz & Leist Electric Co	84
Jenkins Brothers	90
Johnson Mach. Co., Carlyle	20
Jones & Lamson Mach. Co. 12, 13 and	38
Kelly Co., R. A	97
Kempsmith Mfg. Co	22
Kent & Co., Edwin R	74
Kern Machine Tool Co	101
Keuffel & Esser Co	97
Keyless Lock Co	70
Keystone Steel Casting Co	72
Keystone Watch Case Co	94
Kilbourne & Jacobs Mfg. Co.	74
Kinsey Co., The E. A	99
Knight Machinery Co., W. B.	67
Landis Machine Co	69
Landis Tool Co	47
Lapointe Mach. Tool Co	67
Lea Equipment Co	101
Le Blond Machine Tool Co. R. K...4th cover	
Le Count, Wm. G	76
Lincoln Motor Works Co	84
Link-Belt Co	98
Lodge & Shipley Machine Tool Co	4
Long & Allstatter Co	99
Lumen Bearing Co	72
Lunkenheimer Co., The	90
Lyon Metallic Mfg. Co	99
Main Belting Co	98
Mfg. Equip. & Eng. Co	32
Manufacturers Foundry Co.	72
Maris Brothers	88
Marshall & Huschart Machinery Co	95
Mass. Saw Works	24
McCabe, J. J...64 and	94
McDowell, Stocker & Co	94
McLeod & Henry Co	65
Merritt & Co	93
Merritt, Jos	70
Milton Mfg. Co	57
Miner & Peck Mfg. Co	71
Moore Co., Franklin	88
Morris Fdry. Co., Jno. B	14
Morse Chain Co	65
Morse Twist Drill & Machine Co	49
Morton Mfg. Co	92
Mossberg Wrench Co	93
Motch & Merryweather Machinery Co	95
Mueller Mach. Tool Co	69
National-Acme Mfg. Co...102	
National Machinery Co	71
Nash Co., Geo...102	
New Britain Machine Co	68
New Haven Mfg. Co	66
New Process Rawhide Co.	81
Newton Machine Tool Works	11
Nicholls, W. S	88
Nicholson File Co	17
Nicholson & Co., W. H	67
Niles-Bement-Pond Co., 34, 35, 36,	96
Nolte Brass Co	90
Northern Electrical Mfg. Co.	83
Northern Engineering Works	88
Norton Co	61
Norton Grinding Co	30
Nuttall Co., R. D	80
Nutter, Barnes & Co	68
Obermayer Co., The S	72
Oesterlein Machine Co	94
O. K. Tool Holder Co	74
Olds Gas Power Co	90
Owen Machine Tool Co	22
Page-Storms Drop Forge Co.	71
Parker Co., Chas	75
Patterson, Gottfried & Hunter, Ltd.	86
Pawling & Harnischfeger	88
Paxson Co., J. W	74
Philadelphia Bourse	67
Philadelphia Gear Works	80
Phosphor Bronze Smelting Co	72
Pike Mfg. Co	57
Poole Co., J. Morton	67
Potter & Johnston Mach. Co.	53
Pratt Chuck Co	77
Pratt & Whitney Co...2 and	3
Prentice Bros. Co	29
Prentiss Tool & Supply Co	94
Queen City Mach. Tool Co	71
Rahn-Carpenter Co	70
Ransom Mfg. Co	78
Reed Mfg. Co	75
Reichhelm & Co., E. P...4th cover	
Reinforced Brazing & Mach. Co	100
Ridgway Dynamo & Engine Co	84
Rivett-Dock Company...3d cover	
Rivett Lathe Mfg. Co...3d cover	
Rockford Machine Tool Co	93
Rock Island Tool Co	75
Rockwood Mfg. Co	89
Rogers Works, John M	92
Rogers & Hubbard Co	72
Roth Bros. & Co	84
Rowell Co., W. G	74
Sackmann, W. L	70
Safety Emery Wheel Co	78
Sampson Co., Geo. H	87
Saunders' Sons, D	66
Sawyer Gear Works	80
Schieren & Co., Chas. A	92
Schumacher & Boye	9
Scranton & Co., The	74
Sebastian Lathe Co	64
Sellers & Co., Wm	28
Seneca Falls Mfg. Co	62
Shultz Belting Co	92
Sibley Machine Tool Co	25
Skinner Chuck Co	76
Skinner Shipbuilding & Dry Dock Co	70
Slate Machine Co., Dwight	86
Sloan & Chace Mfg. Co	59
Slocomb Co., J. T	79
Smith Countershaft Co	31
Smith & Mills	93
Soltmann, E. G	97
Spacke Machine Co., F. W	86
Spicer Universal Joint Mfg. Co	93
Sprague Electric Co	85
Springfield Machine Tool Co.	15
St. Mary's Machine Co	90
Standard Connecting Rod Co.	90
Standard Engineering Works	84
Standard Gauge Steel Co	68
Standard Tool Co	63
Stark Tool Co	93
Starrett Co., L. S	33
Steptoe Shaper Co., John	88
Stoever Fdry. & Mach. Co.	91
Straley & Hasbrouck	71
Struthers-Wells Co	90
Sturtevant Co., B. F	27
Sweet & Doyle Valve Co	75
Tabor Mfg. Co	74
Tate, Jones & Co	65
Taylor & Fenn Co	68
Taylor-Wilson Mfg. Co	80
Toomey, Frank	94
Triumph Electric Co	84
Trump Bros. Machine Co	76
Turner Brass Works	70
Turner Mach. Co	91
Union Twist Drill Co	55
United Engineering & Fdry. Co	26
U. S. Electrical Tool Co	78
Van Dorn & Dutton Co	80
Vandyck Churchill Co	27
Vitrified Wheel Co	79
Von Wyck Machine Tool Co.	70
Wagner Electric Mfg. Co	84
Walcott & Wood Machine Tool Co	71
Waltham Machine Wks	92
Waltham Watch Tool Co	93

	PAGE
Ward & Sons, Edgar T.	73
Warner Instrument Co.	92
Warner & Swasey Co.	100
Waterbury Farrel Fdry. & Mach. Co.	67
Waterbury Gear Co.	81
Watson-Stillman Co.	65
Wells Bros. Co.	25
Westcott Chuck Co.	76
West Haven Mfg. Co.	4th cover
Westinghouse Elec. &Mfg. Co.	83
Westmacott Gas Furnace Co.	74
Weston Elec. Instrument Co.	86
Whitcomb-Blaisdell Machine Tool Co.	19
Whitman & Barnes Mfg. Co.	102
Whitney Mfg. Co.	43
Whiton Machine Co., D. E.	76
Wiebusch & Hilger	97
Wiley & Russell Mfg. Co.	92
Williams Valve Mfg. Co., D. T.	30
Wilmarth & Morman Co.	78
Windsor Machine Co.	67
Wood's Sons Co., T. B.	89
Woodward & Powell Planer Co.	86
Worcester Machine Screw Co.	93
Wormer Machinery Co., C. C.	95
Wyman & Gordon Co.	4th cover
Yale & Towne Mfg. Co.	88

Classified Index to Articles Advertised

Abrasive Materials
Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Cortland Cor. Wheel Co., Cortland, N. Y.
Norton Co., Worcester, Mass.
Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air
Ingersoll-Rand Co., New York.

Air Lifts
Ingersoll-Rand Co., New York.

Alundum
See Grinding Wheels.

Arbor Presses
Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors
Butterfield & Co., Derby Line, Vt.
Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arches, Boiler Door
McLeod & Henry Co., Troy, N. Y.

Architects
Dodge & Day, Philadelphia, Pa.

Barrels, Steel
Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling
Baird Machine Co., Oakville, Ct.

Bars, Boring
Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller
Boston Gear Works, Norfolk Downs, Mass.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Belt Dressing
Cling-Surface Mfg. Co., Buffalo, N. Y.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Rhoads & Sons, J. E., Phila., Pa.
Shultz Belting Co., St. Louis, Mo.

Belt Filler
Rhoads & Sons, J. E, Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belting, Leather
Main Belting Co., Phila., Pa.
Rhoads & Sons, J. E., Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co, St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Benches, Work
Manufacturing Equipment & Engineering Co., Boston, Mass.

Bending Machinery, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machinery, Plate
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machinery, Power
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand
Wallace Supply Co., Chicago, Ill.

Blanks, Nut and Screw
Dyson & Sons, Jos., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

Blowers
American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines
General Electric Co., New York.
Keuffel & Esser Co., New York.
Soltmann, E. G., New York.

Blue Print Paper
Keuffel & Esser Co., New York.
Soltmann, E. G., New York.

Boilers
Struthers-Wells Co., Warren, Pa.

Boiler Setting
McLeod & Henry Co., Troy, N. Y.

Bolt and Nut Machinery
Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd, John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., East Hampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.

Bolt and Nut Machinery —*Continued.*
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads
Lang Co., G. R., Meadville, Pa.

Bolts, Coupling
Cleveland Cap Screw Co., Cleveland, Ohio.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Technical
American School of Correspondence, Chicago, Ill.
Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.
Piers, Frank, Philadelphia, Pa.

Boosters
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Horseless Age, New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.

Boring and Turning Mills, Vertical —*Continued.*
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, Ohio.
Lyon Metallic Mfg. Co., Aurora, Ill.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

Brazing
Reinforced Brazing & Machine Co., Pittsburg, Pa.

Broaching Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers
Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum
See Grinding Wheels

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Cast Iron Brazing
Reinforced Brazing & Mach. Co., Pittsburg, Pa.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.
Rowell Co., W. G., Bridgeport, Ct.

Castings, Die Molded

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Keystone Steel Casting Co., Chester, Pa.
Manufacturers Foundry Co., Waterbury, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel

Bethlehem Steel Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.
Keystone Steel Casting Co., Chester, Pa.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Bartlett, E. E., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold

Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.

Chucks, Drill —*Continued.*

Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor, Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Woods Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic

Sturtevant Co., B. F., Hyde Park, Mass.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compound, Slushing

Warren Bros. Co., Boston, Mass.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Mon tour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Cambridge, Mass.
Iroquois Machine Co., Providence, R. I.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Link-Belt Co., Philadelphia, Pa.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Corundum

See Grinding Wheels.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S, Athol, Mass

Counters, Machinery

Hebert & Co., J. R., Brooklyn,
Veeder Mfg. Co., Hartford, Ct.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.

Couplings, Shaft—*Continued.*

Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Box & Co., Alfred, Phila., Pa.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co, New York.
Underwood & Co., H. B., Phila., Pa.

Crank Shafts

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Cyclometers

Veeder Mfg. Co., Hartford, Ct.

Diamond, Tools

American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.
Safety Emery Wheel Co., Springfield, Ohio.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittintineague, Mass.
Noyes Mfg. Co., Waynesboro, Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Bench
—Continued.

Slate Mach. Co., Dwight, Hartford, Conn.

Drilling Machines, Boiler

American Tool Wks, Co., Cin. O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Dallett Co., Thos. H., Phila., Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric

Chicago Pneumatic Tool Co., Chicago, Ill.
Dallett Co., Thos. H., Phila. Pa.
Independent Pneumatic Tool Co. Chicago, Ill.

Drilling Machines, Multiple Spindle

American Tool Wks Co., Cin. O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York. delphia, Pa.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Mach. Co., Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co, Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros., Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, Ohio.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Mach. Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Coates Clipper Mfg. Co., Worcester, Mass.
Cincinnati Electrical Tool Co., Cincinnati, O.
Dallett Co., Thos., H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Clayton Air Compressor Works, New York.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hisey-Wolf Mach. Co., Cin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co, Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Eectric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr. & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
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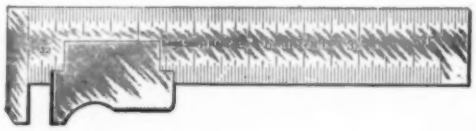

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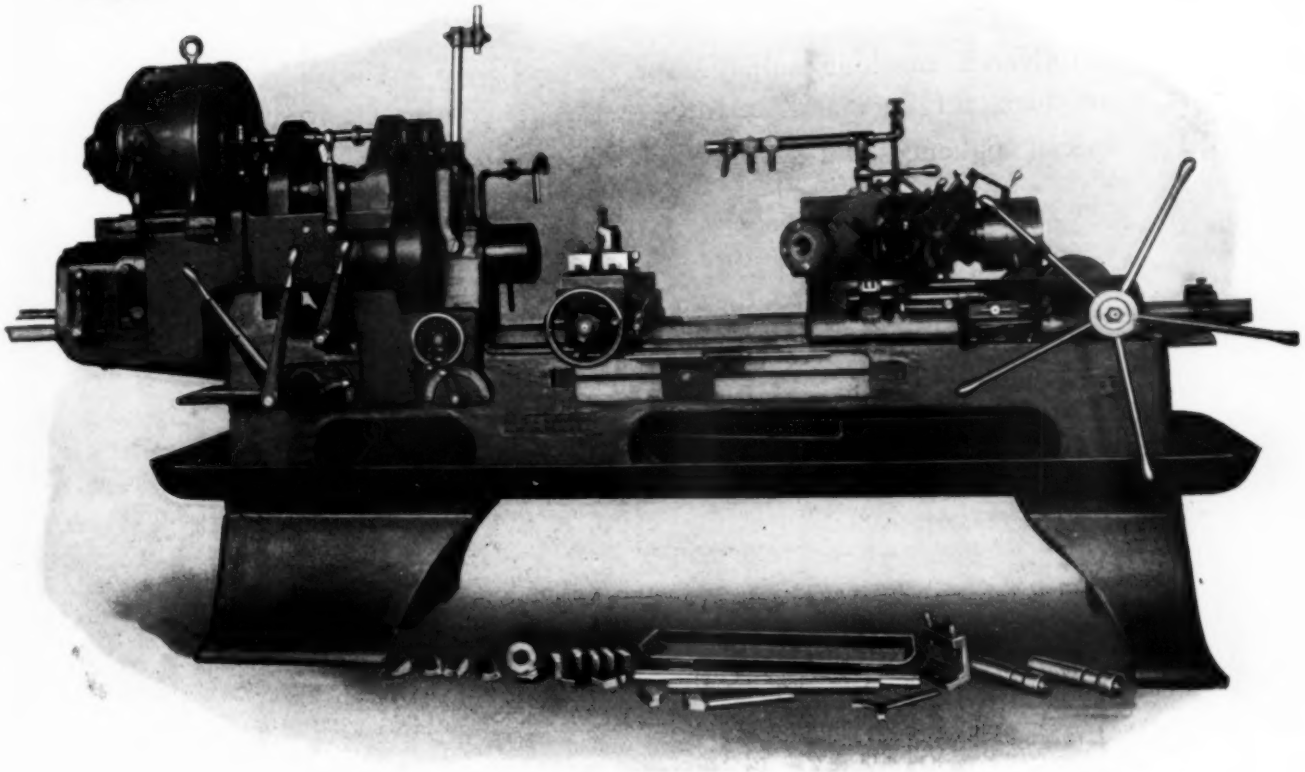

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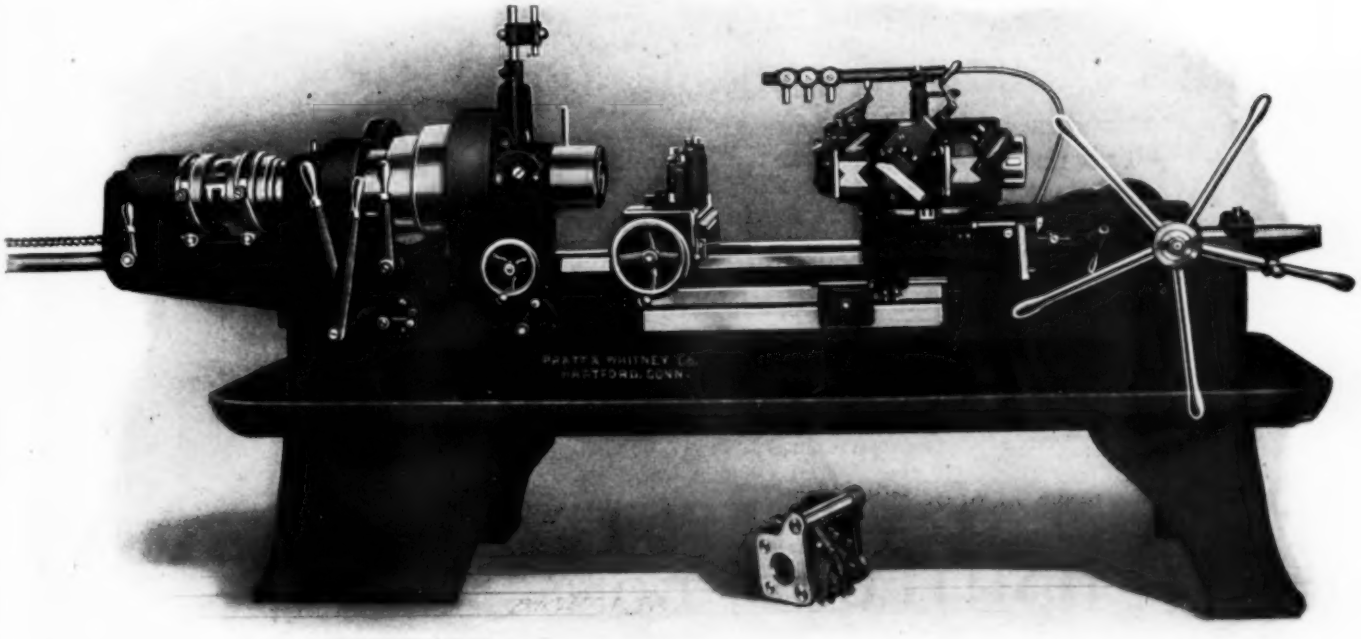

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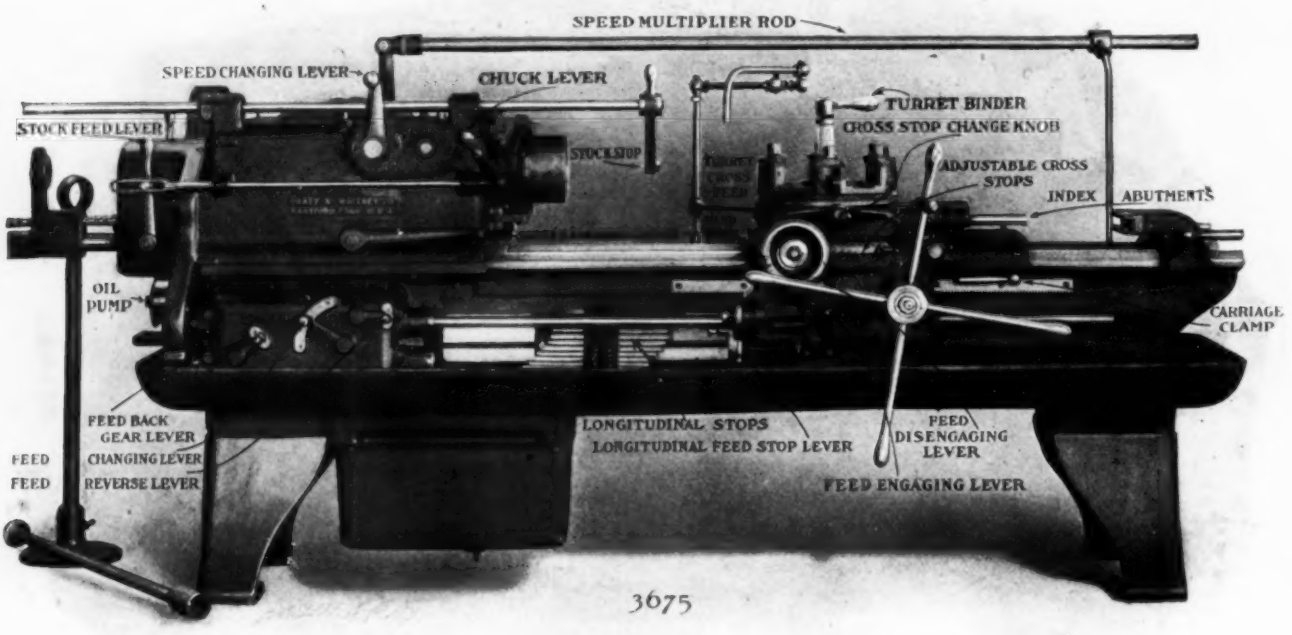

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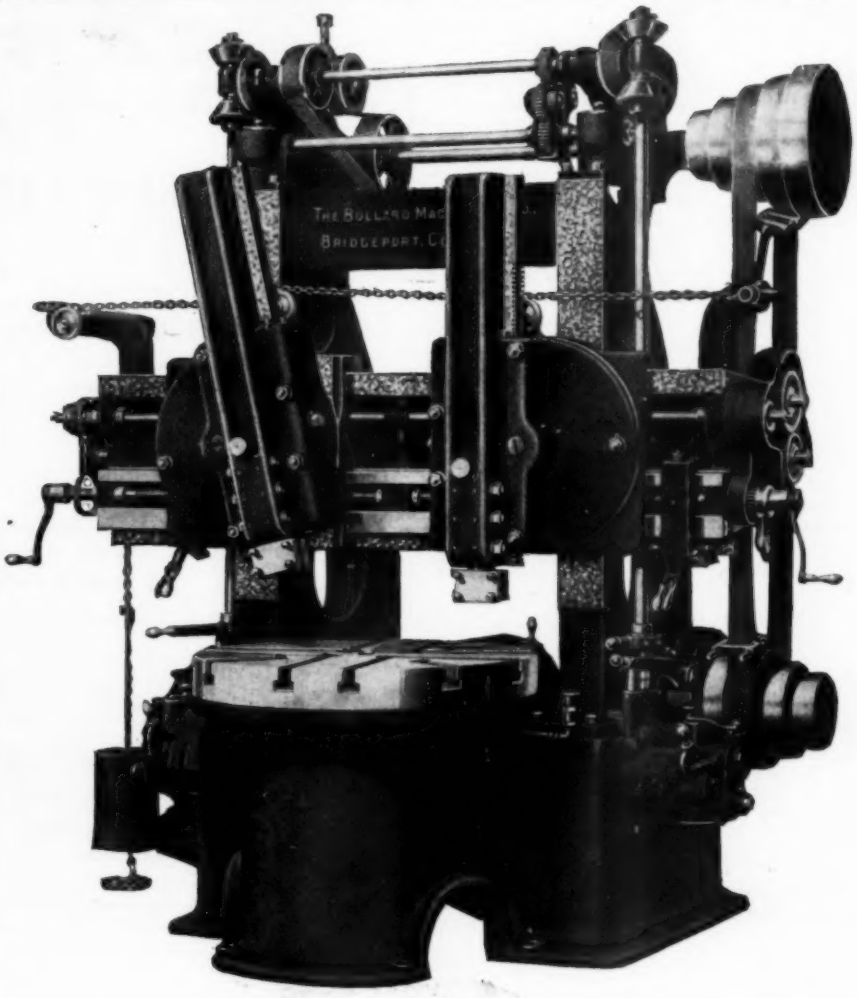

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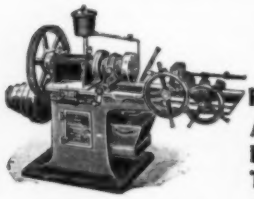

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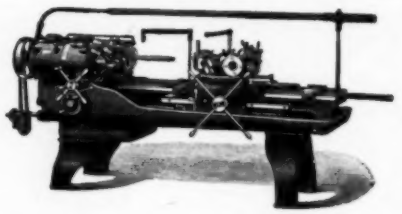

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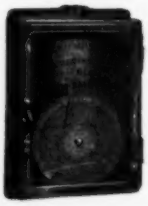

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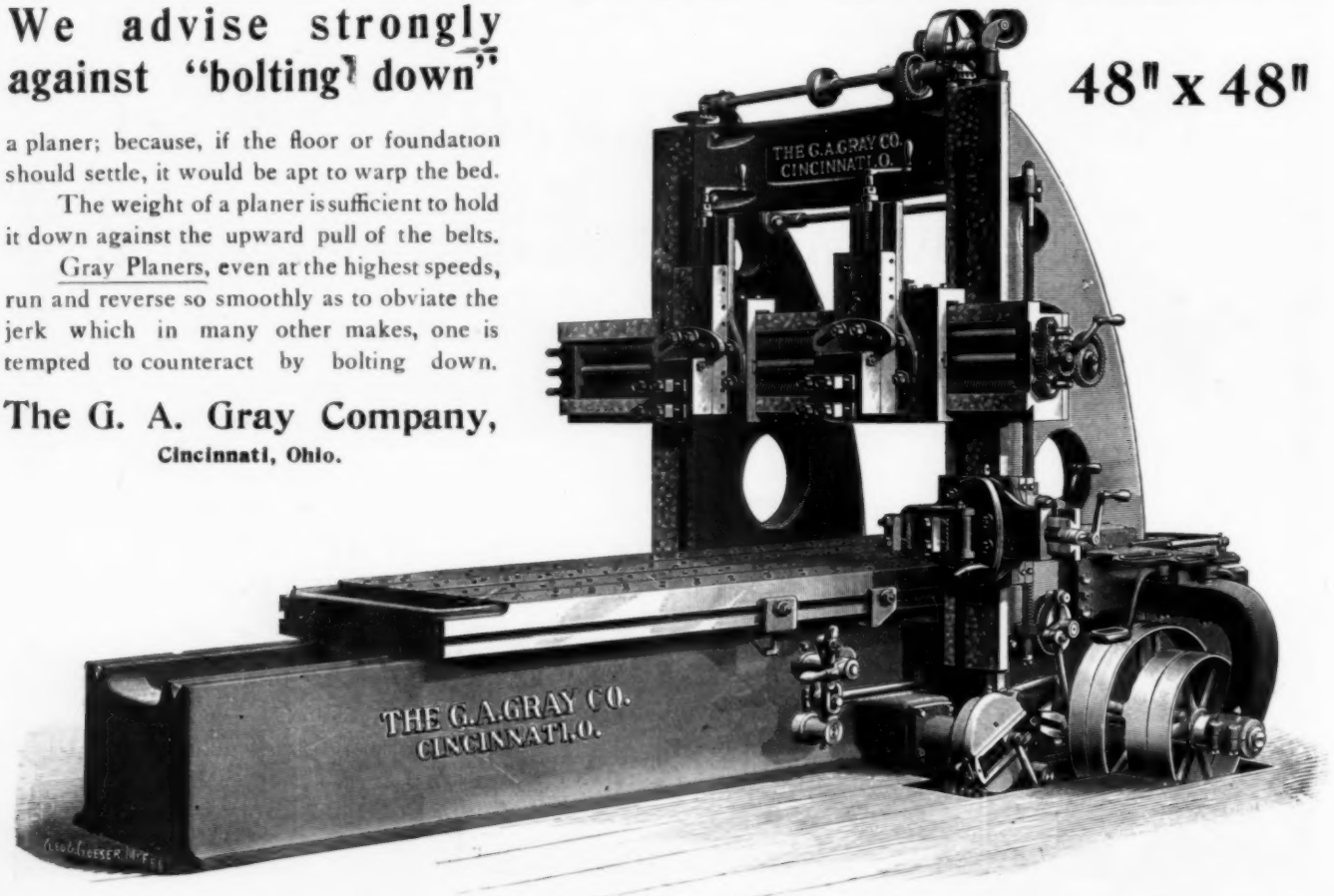


Work of the Floor-plate Boring Mill

Photographs of Original Shop Methods Showing the Wide Range and Great Flexibility of a Novel Home-made Tool

EDITORIAL CORRESPONDENCE

The reader will no doubt recall the highly interesting floor-plate boring mill, at the Crocker-Wheeler Electric Company's works, of which half-tones and construction drawings were published on page 581 of Vol. 28, Part 2. The machine was shown in course of erection before any work had been done by it, and, indeed, before the supplementary portable tools, which form an essential part of its equipment, were made. The article pointed out the fact that the range of application of such a tool is very large, and several methods of handling work were described, although in the nature of the case none of them could be shown. The accompanying half-tones show three such methods.

In order to refresh the reader's memory regarding the scheme of the machine, the half section, Fig. 4, is repeated from the previous article. The revolving table, as will be seen from the half-tones, is flush with a surrounding stationary floor plate, but unlike all previous boring mills, it does not go to the center of the circle. On the contrary, this table forms a ring only, extending in width inward to the point *a*. Within this point the main casting, which supplies the supporting bearing *b*, projects up flush with the surface of the table, and, of course, is stationary, the ring revolving about it. The idea is that this central stationary portion shall be used for mounting stationary tools for boring work carried by the revolving portion, or, *vice versa*, the tools may be mounted on the revolving portion for turning work held on the stationary part.

Inasmuch as this central portion of the table is rather small, a supplementary plate *c* is arranged to be bolted to the central portion, and extending beyond it and overhanging the inner diameter of the revolving table, it provides, as will be seen, a larger base on which tools or work may be mounted.

Fig. 1 illustrates the boring of a medium-sized generator ring frame using the arrangement described. The central stationary enlarging plate is plainly shown, a portable tool holder being mounted on it, while, surrounding it and bolted to the revolving part of the table, is the piece of work.

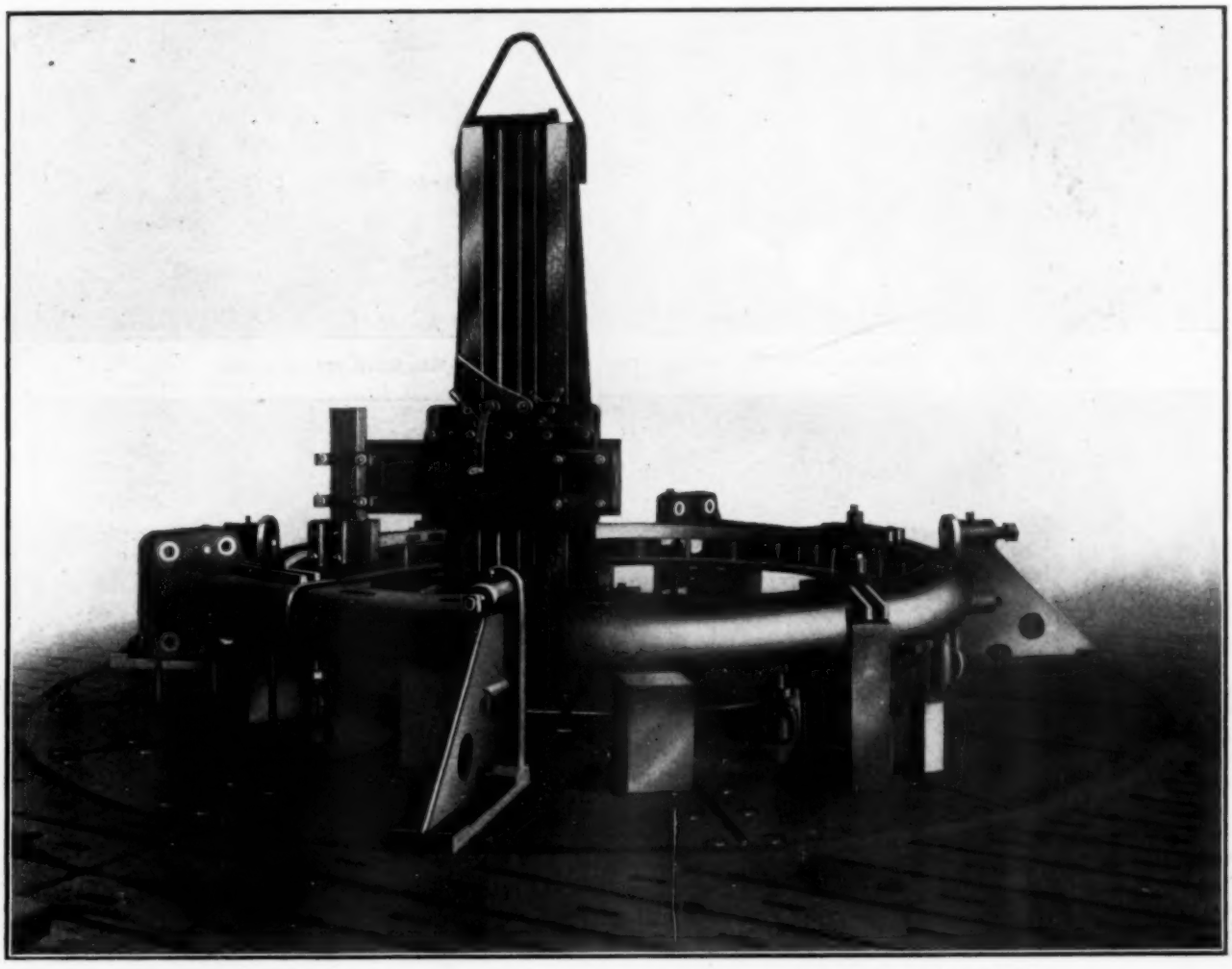


FIG. 1. BORING A MEDIUM-SIZE RING FRAME—THE WORK REVOLVES; THE TOOL STANDS STILL

Fig. 2 shows the application of the machine to a much larger piece of work, and one which would tax a boring mill of the ordinary type. In this case the ring frame is bolted to the surrounding stationary floor plate, while the tool holder is bolted to the revolving plate—a supplementary plate intervening between the tool holder and the revolving table in order to obtain the required reach.

Fig. 3 shows still another application in which the work is bolted to the revolv-

FIG. 2. BORING A LARGE RING FRAME—THE TOOL REVOLVES; THE WORK STANDS STILL

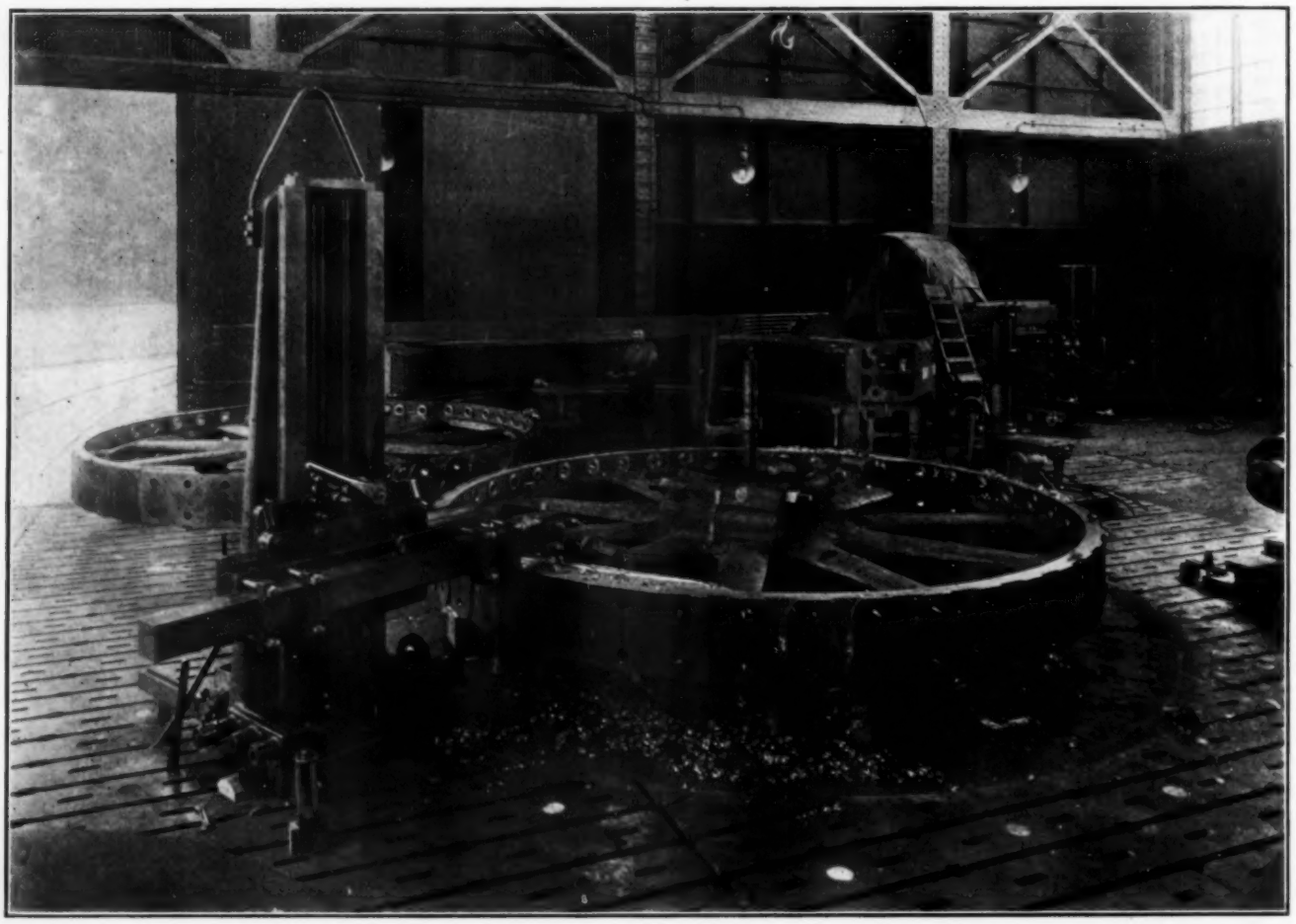


FIG. 3. FACING A ROTOR—THE WORK REVOLVES; THE TOOL STANDS STILL

ing table, while the tool holder is secured to the floor plate, the operation in this case being the facing of the side of a rotor.

For the pieces of work shown, means of centering are, of course, necessary; this is provided through a plug which is dropped in the central hole *d*, Fig. 4, of the central stationary part of the plate, this plug containing in its center a Morse taper hole, in which a staff is inserted, a tram being swung from the staff in order to center the work. The staff is shown in Figs. 2 and 3.

The tool holder shown is of the Espen-Lucas make, and deserves notice. Referring to Fig. 1 or 3, the column will be seen to contain at its right a screw, and at its center and left splined shafts. The central shaft is driven by gearing from below, this gearing being actuated by a star feed, shown in Fig. 3, and being reversible by a clutch. Connections are made behind the ram slide with either the screw at the right or the splined bar at the left, by means of clutches, of which the handles will be seen in the figures. By engaging the screw at the right, a vertical feed is given to the entire ram head, while by engaging the splined bar at the left a horizontal feed is given; and these feeds may be made to work in either direction by means of the reversing gearing at the bottom of the central shaft already mentioned.

The design of this machine was made at the Crocker-Wheeler works, and, except for the driving gear of the main table, it was entirely home-made. It has been in continuous commission since its completion, and has become indispensable in the work of the shop.

It should be mentioned that the original design contemplated the use of an independently driven boring bar, for which provision is made by the hole in the center of the stationary part of the table. The construction of this bar has not yet been found necessary, but should it be made, the reader will observe that a third method of boring suitable for smaller holes and additional to those shown in Figs. 1 and 2, will then be provided.

F. A. H.

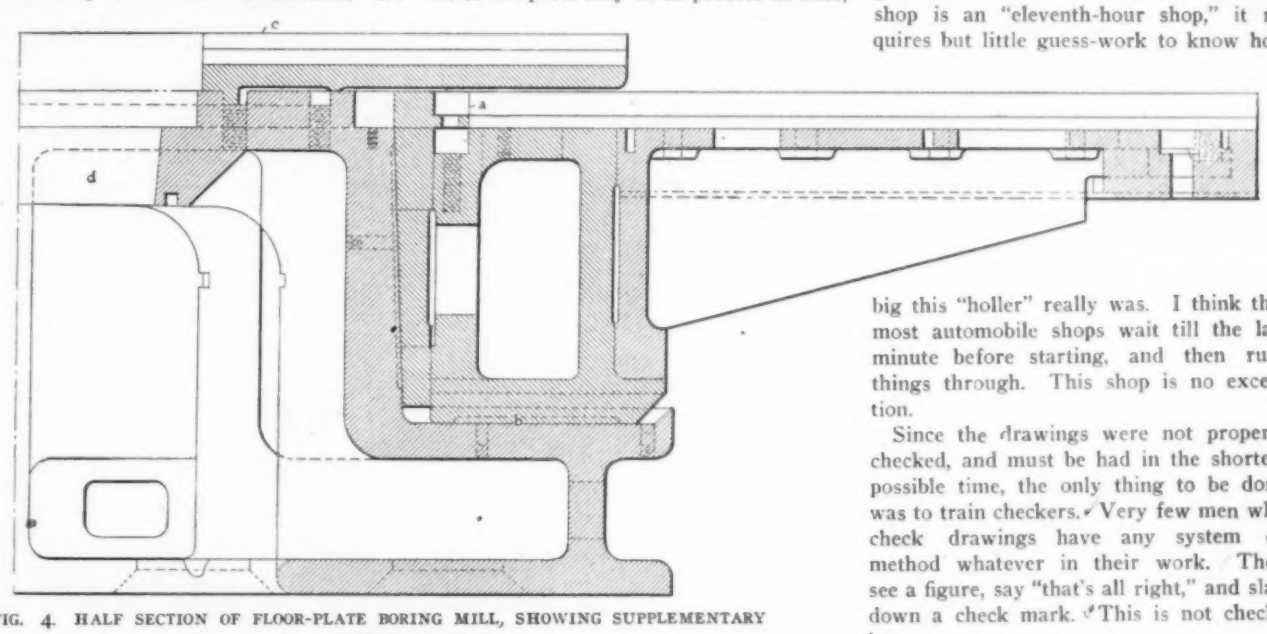


FIG. 4. HALF SECTION OF FLOOR-PLATE BORING MILL, SHOWING SUPPLEMENTARY STATIONARY PLATE

Pointers for Checking Drawings

By Graham

In order that a drawing room shall be a profitable investment for the management, there can be no point of greater importance than the thorough and correct checking of drawings. If drawings are correct, then as many workmen may be set to work as there are pieces shown, giving one piece to a person. In this way all of the parts may be in process at once, with assurance that the parts will fit properly in assembling. Drawings not meeting these requirements are always a menace, for at no time can we say with certainty, "This is right." We are in constant fear of some error in figures, which will cause us not only the loss of labor and material, but also that which is often of greater importance, time.

The saving of a few days of time to a manufacturer often means catching his trade on the "high tide," and the delay may mean the loss of half of what might have been sold by quicker action on his part.

In the proper management of a drawing room especially, there should be adopted the motto, "Be sure rather than sorry;" and another, "Take nothing for granted." It was my fortune to take charge of a drawing room where automobiles were designed, and working drawings ground out. To be truthful, the grist was coming very slowly when I took charge. The first thing to do was to hire more draftsmen, which I did, rapidly increasing the force from a dozen men to more than three times that number. Then the drawings began to come; but how?

I have been a draftsman, made drawings and had to do with drawings for several years, and with all due sympathy with and knowledge of the difficulties draftsmen have to contend with, I can state that the average draftsman is "not on to his job." I believe most thoroughly in individual responsibility in the drawing room, and I found that these men could not check their own drawings nor any others. I must say this much, that most of the boys were unfamiliar with automobile work; this may account for some mistakes. I would not let the drawings go out until they were properly checked, even if the shop did "put up a holler" to get them. When one realizes that this shop is an "eleventh-hour shop," it requires but little guess-work to know how big this "holler" really was. I think that most automobile shops wait till the last minute before starting, and then rush things through. This shop is no exception.

Since the drawings were not properly checked, and must be had in the shortest possible time, the only thing to be done was to train checkers. Very few men who check drawings have any system or method whatever in their work. They see a figure, say "that's all right," and slap down a check mark. This is not checking.

After considerable thought on the matter, and taking the boys into my confidence, I devised the following "pointers for checking," which in our case, I am pleased to say, gave satisfaction and good results at once. It will be noted that in following this order, the checking follows through to the end in such a manner as to make it extremely unlikely that anything important will be overlooked. It is not claimed that this scheme does away with the necessity for gumption, but it does outline a method which saves thinking, "Well, what do I check next?" In our case it worked well, produced results and enabled us to get the drawings out. I therefore offer it to other draftsmen who may be in a similar difficulty, trusting it may be of assistance to them:

Pointers for Checking

1. Design—Is it what we want?
2. Appearance—Is it graceful and adapted to the conditions?

3. Is there interference between the parts and adjoining pieces?
4. Is there clearance for proper working?
5. Is there connection to the other parts?
6. Is material and its temper shown?
7. Are there finish marks; also finish, as file, polish, grind, C' bore, etc?
8. Is draft shown for the patternmaker where necessary, or for appearance?
9. Will the piece draw properly from the sand in the foundry?
10. Are there any undercuts forming pockets in the molding?
11. Is there sufficient information to make the piece? Consider machine work.
12. Are dimensions properly located?
13. Are assemblies located from a fixed point according to our rule?
14. Are there dimensions not tied up?
15. Is there allowance for driving and running fits in thousandths?
16. Is there allowance in bolt and rivet holes?
17. Is there pitch of the thread and the standard on bolts and tapped holes?
18. Is thread of the proper pitch for the metals used?
19. Are the size of the tap drill and clearance drill given?
20. Are nuts and bolts locked? Is there plenty of clearance to use a large wrench on the bolt heads?
21. Are sizes of all bosses suited to their purpose?
22. Are dimensions not properly scaling underlined?
23. Are the title, scale, number, date and notes correct?
24. Are the bolt and screw heads shown correctly?
25. Are tapped holes shown correctly?
26. Are there round corners and fillets?
27. Are there dimensions on springs?
28. Are there fractional dimensions which it is possible to avoid?
29. Are right and left pattern numbers correct?
30. Are there advantages for selling or operating?

What is said to be the largest photograph ever made is a print 12x15 feet, being made as an enlargement from an 8x10 inch negative of President Roosevelt in an Oldsmobile car at Lansing, Mich. The big plate is arrived at by successive enlargements, and the print will be made in a series of strips 60 inches wide, the paper costing some two hundred dollars.

Much trouble is caused in brazing by not using thoroughly fused borax. Dry borax does not answer as it swells while brazing, and makes the joint porous. The borax should be melted in a clay or iron crucible to a clear liquid so as to drive off all water. Such borax will not swell when used for brazing.—*The Brass World.*

A Diagram for Calculating Moments of Inertia

By O. A. Thelin

The accompanying diagram has been designed for the purpose of simplifying calculations relative to moments of inertia of sections. It is intended mainly for special sections composed of rectangular parts, such as tees, channels, I's, angles and other shapes, although it may be employed with advantage for irregular sections by first dividing them into a number of rectangles.

The curve has been constructed according to the formula $I = \frac{Ch^3}{3}$ which gives the moment of inertia for a rectangle of width C and hight h above its reference axis. In the table the rectangle has been considered of unit width, or one inch. The hight above the axis $O\,X$ is measured on the left-hand vertical scale and varies from 1/16 inch to 6 inches. The horizontal scale gives the value of I for each 1/32-inch increase in the hight of the unit section. The curve has been drawn in steps in order to make the horizontal or I values more definite. Should the vertical dimensions of a section run into sixty-fourths of an inch, a middle point between the values for thirty-seconds can easily be read off on the curve.

As the values of I for the unit section become very small below 1 inch in hight, the curve is enlarged 10 times for vertical dimensions between 1 inch and ½ inch, and 100 times for such dimensions below ½ inch in order to give accurate results. For large sections, where the distance from the neutral axis to the extreme fiber exceeds 6 inches but is less than 12 inches, the table may be used with following modifications: Divide all hight dimensions of the section to be figured by 2. Calculate the moment of inertia from the table, write these new dimensions and multiply the result by 8, which will give I for the original section.

A few examples will best show the method of using the table and the advantage it has over the formulas in the saving of time for calculations of such sections as those previously referred to.

For the section, Fig. 1:

From the table for $3\frac{5}{16}$ inch on the vertical scale the corresponding value on the horizontal scale is 12.11.

Then $I = 2.5 \times 12.11 = 30.27$.

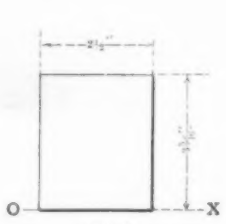


FIG. 1

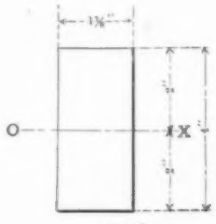


FIG. 2

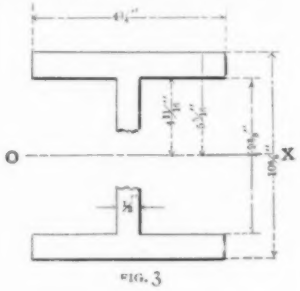


FIG. 3

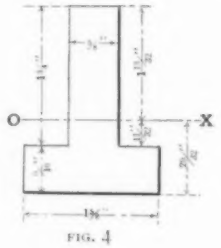


FIG. 4

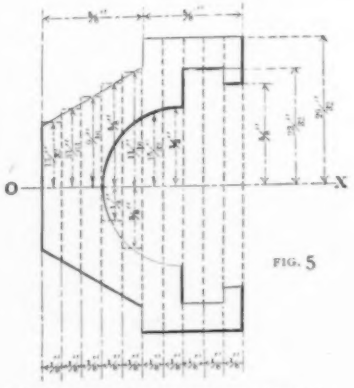


FIG. 5

DIMENSIONED SECTIONS, ILLUSTRATING USE OF DIAGRAM FOR MOMENTS OF INERTIA

For the section, Fig. 2:

$$\frac{I}{2} = 1.875 \times 2.67 = 5.$$

$$I = 10.$$

For the section, Fig. 3:

$$\frac{I}{2} = 4.75\ (49.99 + 34.33) + 0.5 \times 34.33 = 91.55$$

$$I = 183.1.$$

For the section, Fig. 4:

$$I = 0.625\ (0.92 + 0.0135) + 1.625\ (0.248 - 0.0135) = 0.964.$$

For the section, Fig. 5:

$$\frac{I}{2} = \tfrac{1}{8}\{(0.248 - 0.082) + 2\ (0.248 - 0.123) + (0.248 - 0.0415) + (0.248 - 0.0345) + (0.107 - 0.0175) + (0.082 - 0.0052) + 0.059 + 0.0314 + 0.0224.\}$$

$$I = 0.2788.$$

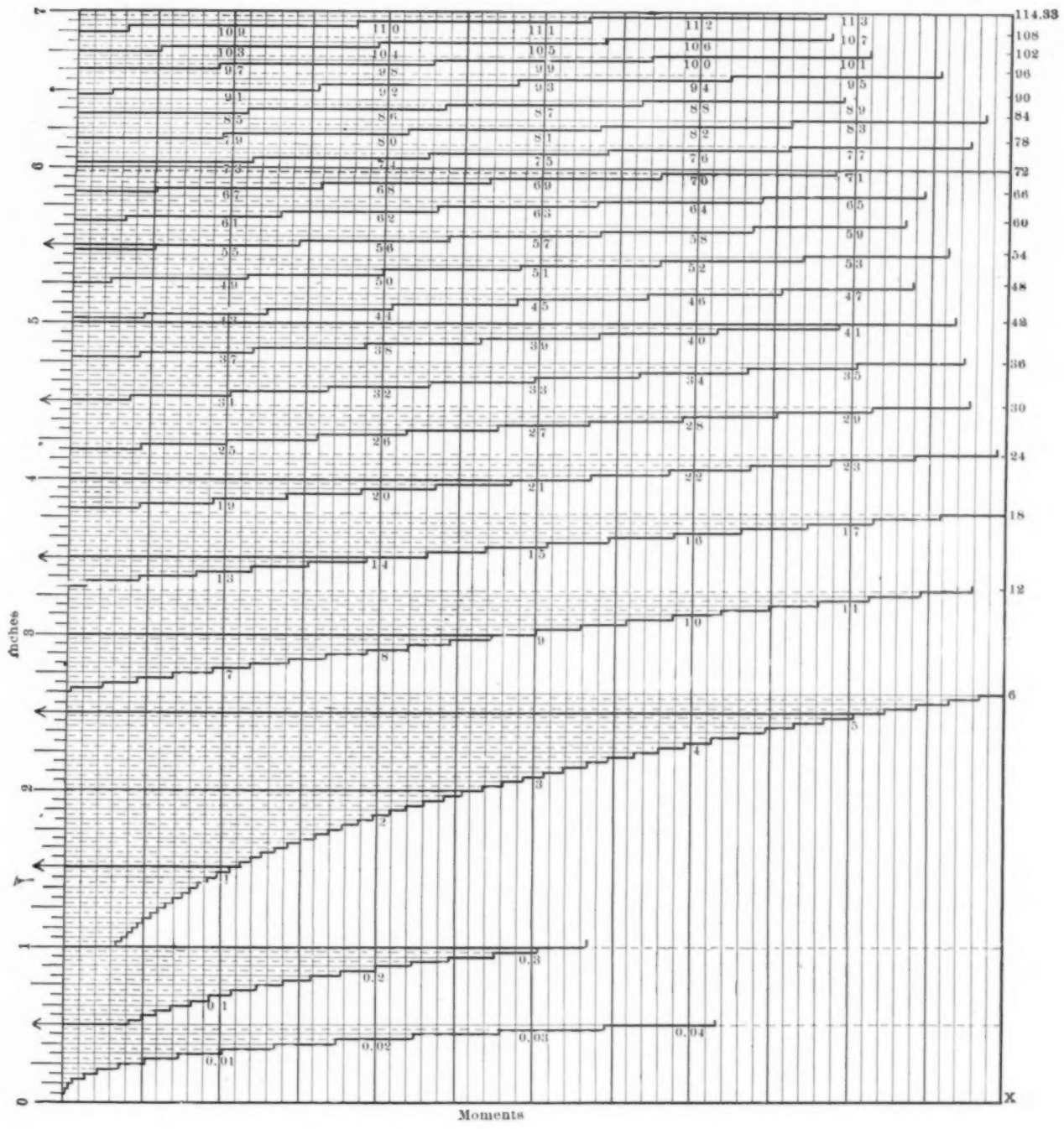


Diagram for Computing Moments of Inertia

Explanatory:

Consider the bottom line *OX* as the neutral axis of the section. Use the left-hand vertical for the hight of the section above the neutral axis.

Read moments of inertia in a horizontal direction on the stepped curves. The value thus determined is for unit width, 1 inch, and for the part of the section above the axis.

The steps are 1/32 inch in each case. Values of the moment at different points of the curve are indicated by the number at the right hand vertical and by the numbers in the body of the diagram.

Read moments in units and decimals.

As the moment curve is plotted for unit width, to find the moment of inertia for a simple rectangle with neutral axis coinciding with the axis of figure, multiply the value found by inspection of the curve, corresponding to one-half the hight of the section in inches, by the width of the section, and by the factor *two*. The result is the moment required.

The diagram can be used in computing the moments of inertia of simple sections by dividing them into rectangles and computing each one separately. For more complicated sections, irregular in shape, divide into a number of equivalent rectangles and compute each one separately. For sections having hight dimensions above the axis of between 7 inches and 14 inches divide the hights by two, determine the moment with these dimensions and multiply the result by 8. The result will be the moment of inertia of the original section.

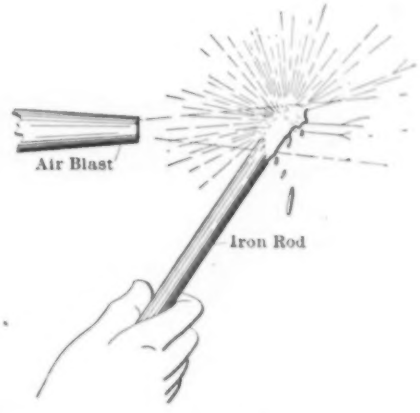
The Spark Method for Grading Steels

By Albert F. Shore, M. E.

How many steel men and toolmakers are there who can tell exactly what kind of steel is in a bar if the familiar signs and labels have been marred, or if the specimen has become a little rusted? Most toolmakers prefer to chip a piece of the bar with a cold chisel, heat and chill it, and if it hardens it must be tool steel. In these days of high-carbon machinery steels and in view of the fact that small bits of steel harden more easily than larger pieces, these tests are often misleading, inasmuch as high-carbon machinery steel will harden enough to resist the file, and thus test like tool steel.

The method which I will describe depends on the action of the oxygen of the air on the more combustible elements contained in different steels, which tend to act explosively when the proper temperature has been reached. To produce a bright spark as the result of heating microscopic particles of metal, as by grinding or by casting filings into a flame, certain conditions are necessary to insure success. In the former, there must be enough strength to resist wear or cutting in order to heat the detached particles, and this heat must be intense enough to cause oxidation, while in the latter case, the metal must be subject to combustion at the temperature of the flame, without volatilization, before any amount of light is produced. Now the action of grinding or of a candle flame cannot produce heat enough to volatilize iron or steel, but the heat imparted is ample to cause chemical combination between the oxygen of the air and the iron, which in the process of combustion causes heat of sufficient intensity to ignite the carbon contained in iron and especially steel.

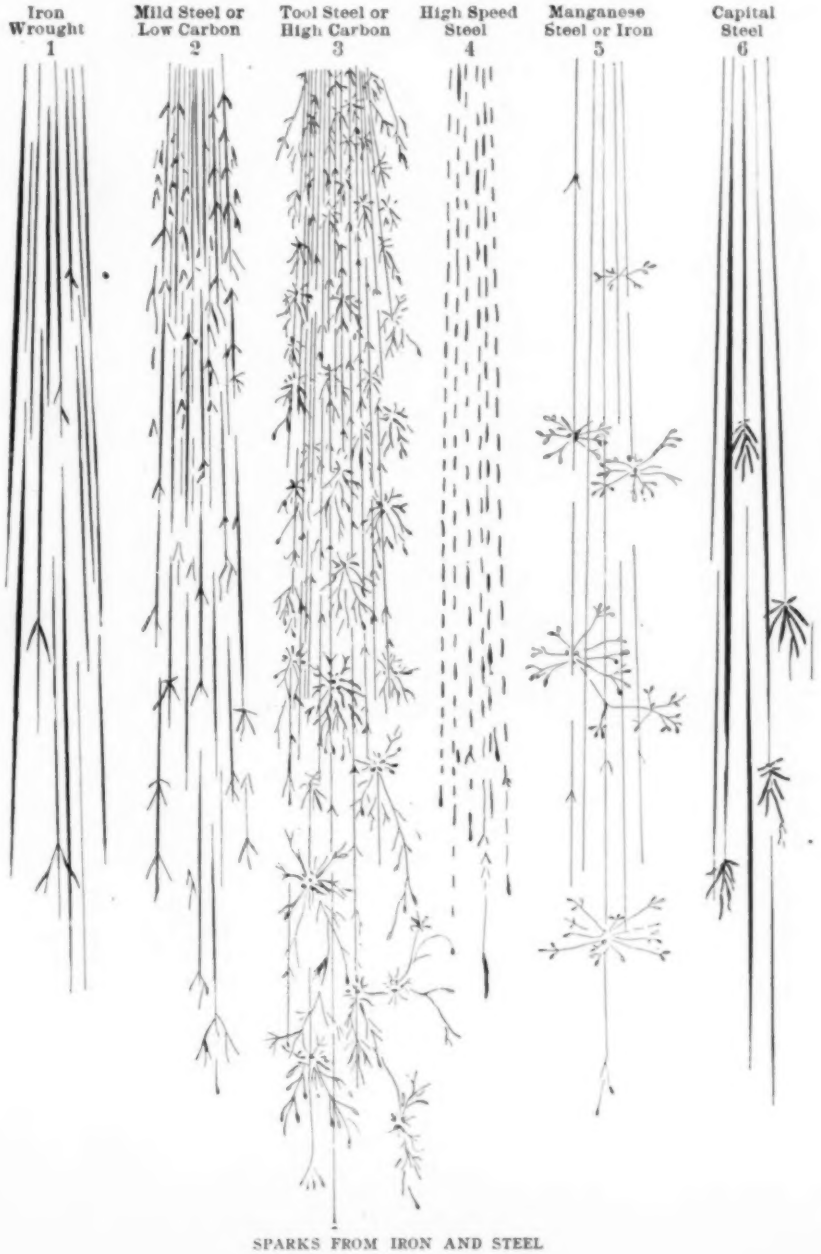
This fact is beautifully demonstrated by the iron torch, shown in Fig. 2. By heating a bar of iron to a welding heat



AN IRON TORCH

and then holding it in a strong air blast, it will at once begin to boil and sizzle, emitting a dazzling bluish-white light. This may be maintained for hours without any source of heat, except that caused by the combustion of the iron. Beginning with let us say slag iron, which is almost free from carbon, the spark test will usually give straight lines, which become broader and more luminous some distance (not over a few inches) from their source, and then disappear as they started (see 1 of Fig. 4.) This peculiarity is probably due to the action of the oxygen on the heated particles requiring some time to act. This effect is at its maximum when the spark streak appears broadest and whitest, and would continue so, but for the reason that the fuel supply is soon exhausted.

By adding a very small percentage of carbon to iron the effect is at once noticeable by a division or forking of the luminous streaks, as in 2 of Fig. 1. This is owing to the presence of the carbon, which is only acted on by the maximum heat of the iron spark, and which then burns explosively, causing a break in the original heavy line. By adding more and more carbon to the steel, the iron lines become less and less conspicuous, and the star-like explosions do not only become extremely profuse, but their rays often divide again and subdivide, causing a beautiful display of curves and figures, as in 3 of Fig. 1. In this instance it should be stated that the iron and carbon have been so united that they are most easily attacked by the oxygen, and hence the great danger of burning tool steel in the process of forging. This readiness to burn may be considerably reduced by the addition of a more refractive metal as tungsten or molybdenum. The former alloy shows not only anti-rusting qualities, but also can endure incandescent heat without scaling or burning. The temper



SPARKS FROM IRON AND STEEL

is thus not drawn so easily and hence the name high-speed steel.

In the spark test these peculiarities are shown as indicated by 4 and 6 of Fig. 1, in which the sparks appear not only simple, but also very dull red. This, however, is easily understood by referring to the foregoing paragraphs where it is shown that the luminosity of iron or steel sparks depends for the most part on the combustion of the iron and carbon. Perhaps one of the most remarkable sparks which enter into this group is characteristic of manganese and widely differs from the familiar carbon stars and rays. Once these diversified signs have been carefully studied, the trained eye will detect the slightest trace of manganese in even what is otherwise a pure carbon steel. Its spark is shown in 5 of Fig. 1. The lateral darts always radiate from an unbroken line and at right angles thereto. The color is dull red and each dart is subdivided into a number of white-hot globules.

Some steelmakers use the method of spark analysis in testing their products, in addition to others, and they agree that it is very reliable.

There are, also, many mechanics who by experience have learned thus to distinguish tool steel from iron or machinery steel, and who are never caught making reamers and cutters of machinery steel, and bolts and screws of tool steel. Most mechanics, seeing a variety of sparks as here shown among different irons and steels, have failed to distinguish any special significance in any particular one, and they on the average are unable to identify a favorite grade of steel by the spark. Perhaps the most misleading spark to be found is the one of gray or cast iron, which being very seldom of a standard purity will often show scarcely any luminous sparks at all. Sometimes it is rich in manganese, and the familiar bright manganese darts are given off at varying distances from the source of heat. Cast iron usually consists of iron with a very high percentage of carbon, which gives it rigidity and hardness. Graphite in iron is that form of carbon which is not chemically united and, therefore, it follows that since it exists in a free state, it must be present in all stages of combination. Thus cast iron will yield sparks ranging from iron to tool steel. In addition to the diversified sparks shown in the diagram there is also much significance in the distance in which they appear from the source of heat as in grinding, which is the most accurate test.

A gas mantle has recently been patented in Germany in which the mantle itself consists of nothing more than an egg shell. The eggshell is converted into a glowing state by means of the combustion of the gas inside, and is said to spread a pleasing and agreeable light.—*The Engineer.*

Reboring a Press Pitman

By A. B. Christman

Not having a lathe large enough to swing the work, we resorted to a novel method for reboring the pitman of our large punch press. In trying to avoid the making of special appliances as far as possible, we evolved the method shown in the illustrations, in which Fig. 1 shows the pitman *A* on the milling-machine platen *P* (clamps not shown) and the cutter *C* in operation. Figs. 2 and 3 are plan and side views of the cutter, and Fig. 4 is a diagram showing in detail the action of the cutter in roughing and finishing operations.

Figs. 2, 3 and 4 show the hole to be 4 inches in diameter, the cutter 3.96 inches and having a hole with two diameters, 1.02 and 1.04 inches, while the arbor or the milling machine upon which the cutter is mounted is 1 inch in diameter. The cutter was alternated end for end for roughing and finishing, to avoid the necessity of the usual cut and try method common with the regular boring bars.

As shown in Figs. 1 and 4, one end *e* of the cutter *C* is engaged while the other end *d* is clearing the opposite side of the hole. By placing the cutter upon the arbor so that the side of the hole opposite to the engaging end of the cutter rests upon the side of the arbor, as at *g*, the required diameter is secured.

After the roughing cut was taken, the cutter was removed from the arbor and the smaller portion of the hole enlarged sufficiently at a point opposite the finishing end of the cutter to permit the larger portion of the hole to rest upon the arbor, locating the cutter correctly for boring a 4-inch hole.

In Fig. 4 it will be seen that that portion of the hole in the cutter which is farthest from the end of the cutter that is engaged rests upon the arbor *B*, as at *a*, while the opposite side of the hole or side nearest the cutting end clears the arbor, as at *b*. Cutter *C* was of course not keyed to the arbor but was faced true at *D* for abutment of regular arbor collars; the recess at *r* was made to permit plenty of side clearance for the finishing end while roughing.

It seems that this principle should solve many boring-bar problems if modified to suit varying conditions.

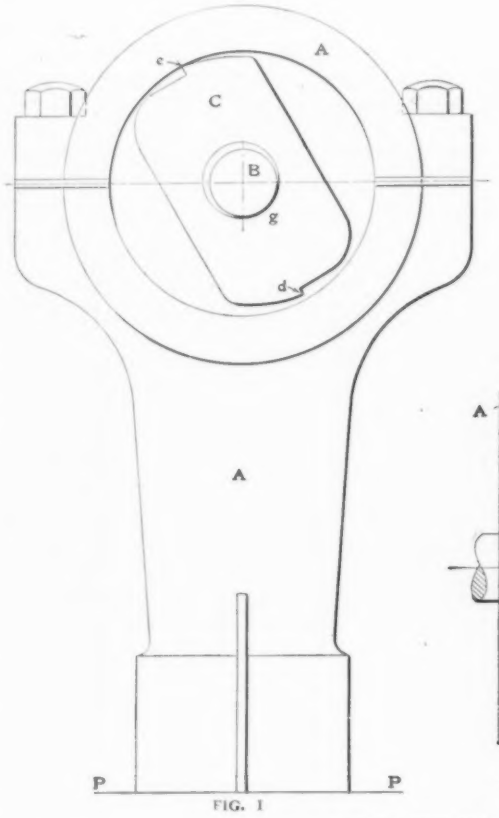


FIG. 1

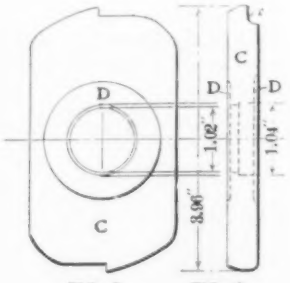


FIG. 2 FIG. 3

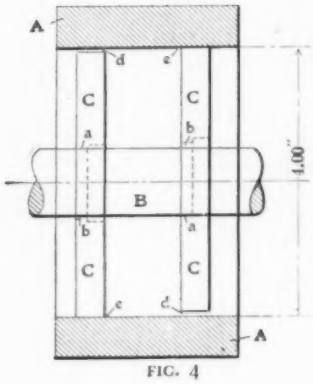


FIG. 4

A NOVEL BORING TOOL

In an interesting article in the *Street Railway Journal* on "Transportation Facilities in South America," it is stated that transportation is so difficult over the mountains that the coal imported into Bolivia for the railway's own use costs about £6 per ton. At La Paz abundant timber grows within fifty miles from the mountains, but transportation is so difficult that trolley poles and lumber for building operations are brought from the State of Oregon, a distance of thousands of miles.

A Large Hydraulic Flanging Press

How the Flanged Work for the P. R. R. System Is Produced by the Use of a Hydraulic Press and Cast-iron Dies

BY E. A. DIXIE

In the boiler shop of the Juniata shops of the Pennsylvania Railroad, at Altoona, Penn., there is some remarkable flanging work done on a large hydraulic press built for them by the Niles-Bement-Pond Company.

As a general proposition this boiler shop handles all press work of a similar nature for the whole system, and it has a capacity for turning out one new boiler and one new tender for each working day.

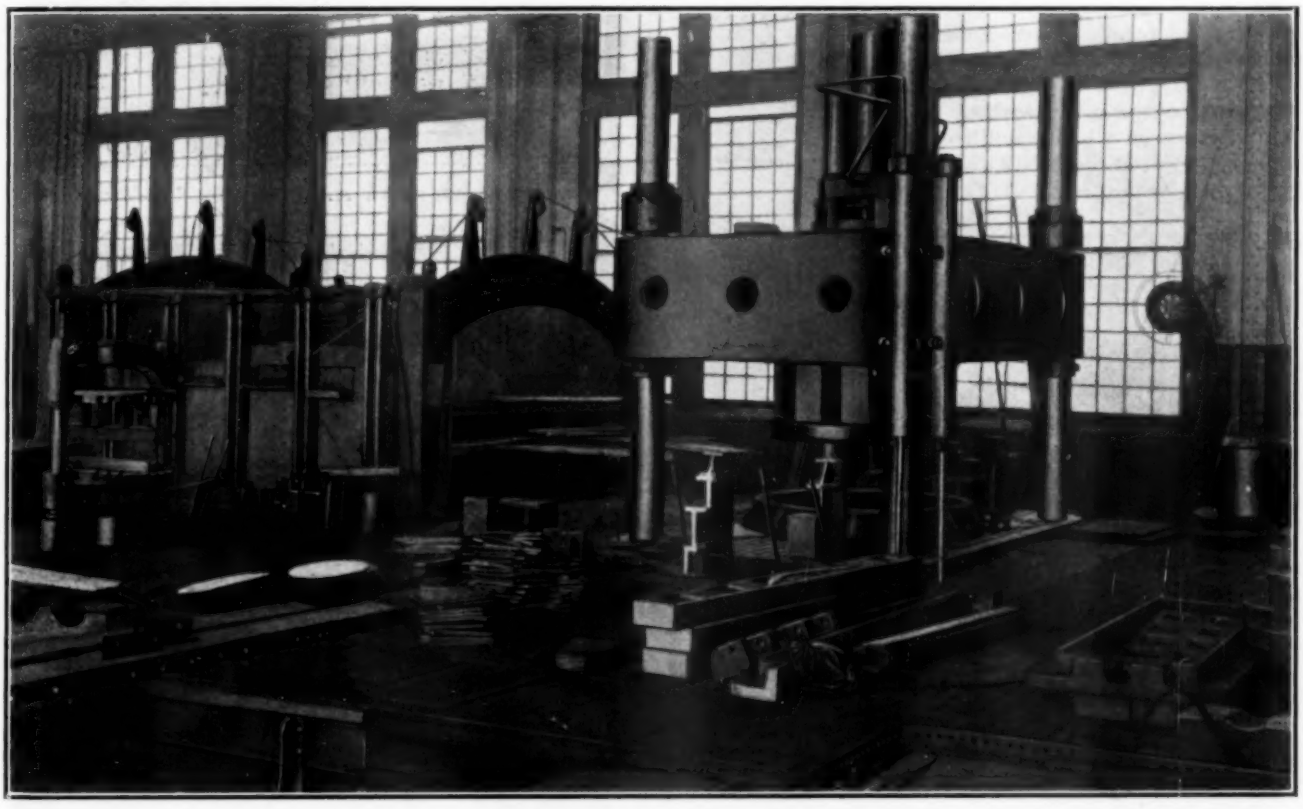


FIG. 1. THE LARGE FLANGING PRESS

Formerly all flanging was done by hand. The work is tedious and difficult and injures the plates, as the hammering on partly cooled plates is very apt to crystallize them. Machine flanging takes a fraction of the time, the plate is handled at the most suitable heat.

Further, the machine flanging results in uniform work, uniform in shape and also in thickness, no thinned parts such as produced by excessive hammering in one place. Then the product is interchangeable and can be shipped to distant points with the assurance that it will fit.

The press itself, with a pair of dies in place is shown in Fig. 1. To the left is the furnace for heating the plates. This furnace is fired with gas. The small press at the left is also used for flanging work within its capacity.

The bed of the large press measures 12 feet by 7 feet 2½ inches. The table can be elevated 6 feet.

The main table or ram has a stroke of 48 inches, and exerts a pressure of 700 tons. Within the main table is a center ram having the same stroke and capable of 200 tons pressure. Four, so called, vise rams are equally spaced around the main table. These are used to clamp the work, the same as holders in drawing operations; they exert a pressure up to 50 tons each. The top ram is movable and of 100 tons capacity.

To the extreme right in Fig. 1, in front of the column at the wall, is the male die for forming the dome shown in the foreground in Fig. 2. In the past, domes have been made in various ways. Formerly they were made in three pieces, as shown in Fig. 11. Some time ago the top pieces were made of steel castings, but that shown in Fig. 11 is press work, made from fire-box steel. The castings from which these top pieces were made cost about $18 each in the rough. The pressed-steel top piece costs, labor and material, about $8 and is superior to the casting in every way. The center piece of the old-style dome is boiler plate. The lower dome flange shown in Fig. 11 is fire-box steel pressed to shape.

The large dome shown in Fig. 2 was made as an experiment to see what could be done in the way of making high or deep draws. The original plate of fire-box steel was 1⅛ inches thick and 69 inches diameter with a 2⅜-inch hole in the center. The plate was heated to about 1400 degrees, as this was found to be the most suitable heat. Plates previously heated as high as 1800 degrees were apt to draw thin or stretch unevenly. The hole in the middle of the plate is used to center it.

In Fig. 3 is shown the method of drawing up these domes. *A* is the plate centered on the lower punch *B* by the projection *G'*. *C* is the die. *D* is the holder plate supported on four hydraulic holder rams under a pressure of 28 tons each.

B is secured to the center ram having a capacity of 200 tons pressure. The

punch *B* is slightly tapered so as to be readily removable from the drawn dome, the taper being 1 inch in 30 inches. *H* is the upper table of the press.

The dome shown in Fig. 2 is 30 inches

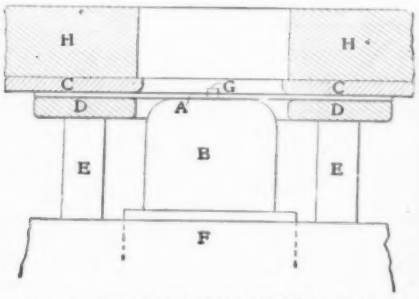


FIG. 3. THE PRESS AND DIES FOR DOME

diameter by 25 inches high and is drawn up to these sizes in four heats. The flange at this stage is about 55 inches diameter; about halfway between crown and flange, the sides are reduced from 1⅛ down to ¾ inch in thickness. The dome goes to the machine shop next, where it is put on a boring mill and the flange is turned on the edge to size and beveled to a calking edge. It then goes back to the flanging machine where another heat and press operation shapes it to the barrel of the boiler, as shown in the dome in the lower left-hand corner of Fig. 8.

Hip Sheets

These hip sheets were of course formerly flanged by hand. A flanging squad for this job consists of one flanger and four helpers. The time consumed was about 10 hours. The result was not to be compared in quality with the machine-flanged plate. The first attempts at machine flanging hip sheets were naturally on one sheet, the same as in hand flanging. It was later decided to try flanging two sheets at the same time. But before trying it on a steel sheet, a small pair of model dies was made and, using a piece of sheet lead, the sheet forced up to the desired shape. With this model it was easy to measure the amount of stretch that had taken place at various points and possible to take precautions to prevent the plate from drawing thin. The precautions taken in this direction are plainly shown in the half-tones Figs. 2, 4 and 5 and in the line cut Fig. 6.

The depth of draw where the gap in the plate is varies from 6 to 7 inches according to the type of boiler the hip sheet

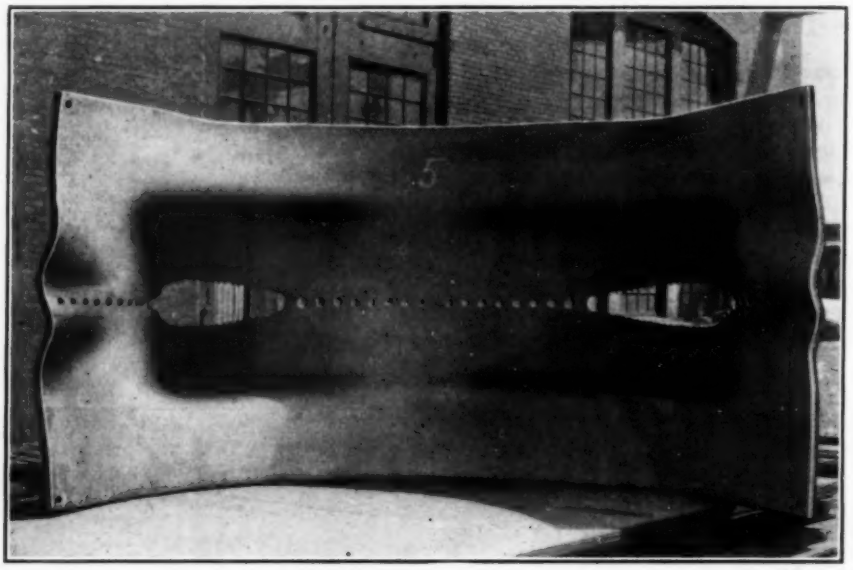


FIG. 5. INSIDE OF HIP SHEET

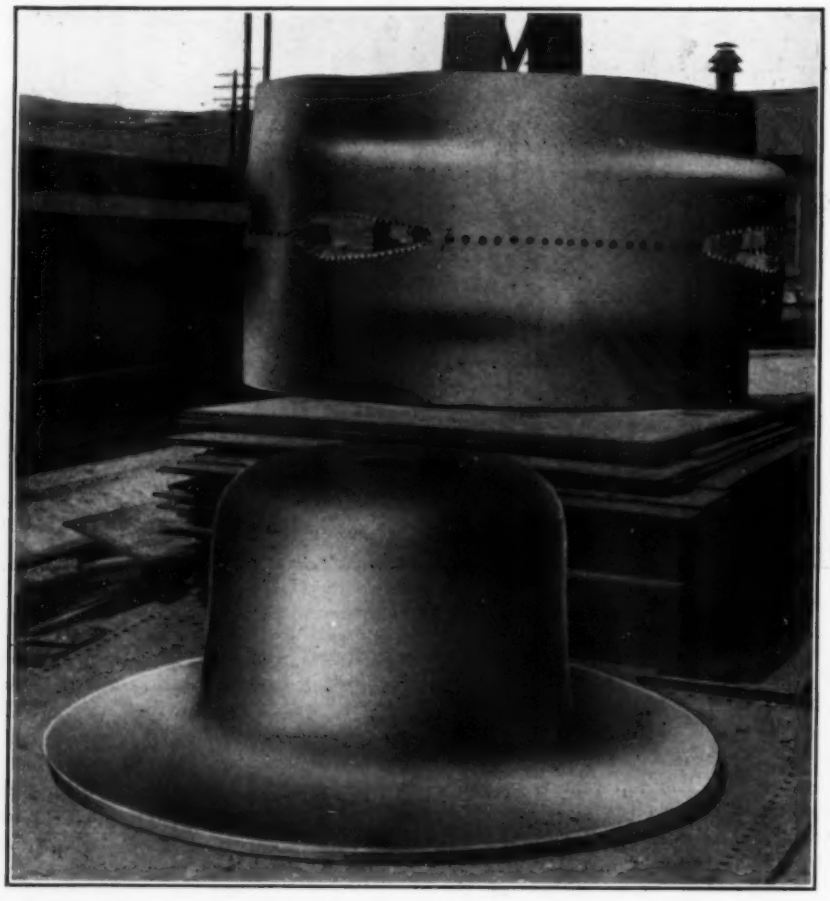


FIG. 2. HIP SHEETS AND DOME

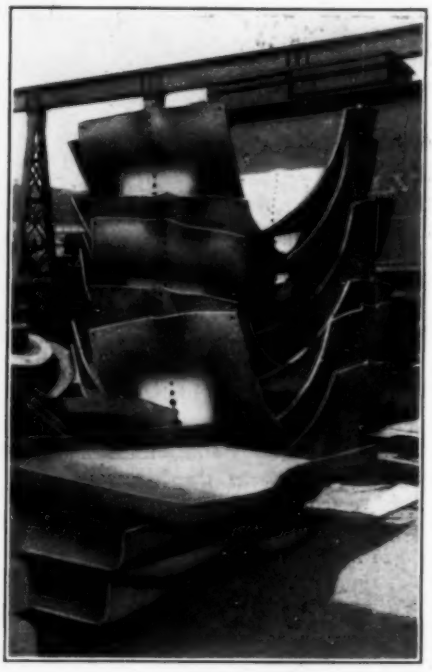


FIG. 4. HIP SHEETS AND FLUE SHEETS

is intended for. That shown is for a type E. 3. A. standard Atlantic type passenger engine.

The plate is laid out as shown in Fig. 6. The holes are punched as shown. The greatest strain comes of course at the deepest draw; that part is for a certain distance punched with the holes and varies for the different types of boilers from 9/16 to 15/16 inch thick.

Tube and Door Sheets

In Fig. 7 in the foreground are shown several piles of tube sheets. These were formerly hand flanged and took about five hours to finish. They are made of fire-box steel ½ inch thick. It takes about 30 minutes to flange them in the machine. In the background in Fig. 7 a pile of door sheets is shown. They are also made of fire-box steel, but are only ⅜ inch thick. Where the doors are oval or round, the flanging is all done in the machine, but rectangular doors, as shown in Fig. 7, are hand flanged, as it is difficult with this shape of door to prevent tearing the plate when machine flanging.

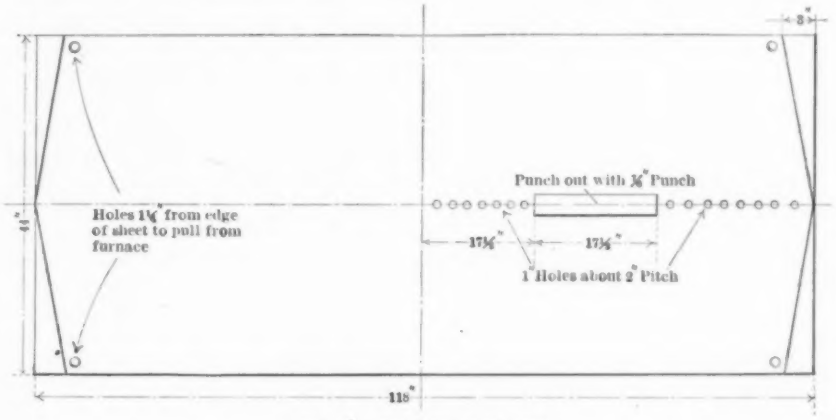


FIG. 6. HIP-SHEET BLANK

Throat Sheets

Fig. 8 shows a variety of pressed shapes. In the center is a pile of throat sheets. The material for these is shaped as shown in the line cut Fig. 9. Close to the upper corners at *A* will be seen two half-round notches. When the sheet is laid in the dies, these notches bear against braces to prevent the plate being pulled by the dies as they come together. Throat sheets took 20 hours to flange by hand; the job is now done in about 40 minutes.

The dome shown in Fig. 8 is 16 inches high, 30 inches inside diameter. The meeting one another. When the dies come together, the plate at this point offers little resistance and the metal is not stretched or thinned, but the plate draws open at the gap.

The machine-made hip sheets are made in pairs. The squad consists of four men instead of five, and a pair of hip sheets is made in about half an hour, or a hip sheet every 15 minutes, instead of every 10 hours. In the machine-made hip sheet there is about 200 pounds less material than in the hand-made one. In Fig. 10, to the left, a hip sheet is shown with rivet holes in it ready for putting into the boiler.

Fig. 4 shows a pile of hip sheets just as they come from the flanging machine. The forming of these sheets is done at one heat. The material is fire-box steel

FIG. 8. THROAT, HIP, TUBE AND DOOR SHEETS AND DOME

FIG. 7. TUBE-HIP AND DOOR SHEETS

round blank from which it was made was of fire-box steel 64 inches diameter by 1⅛ inches thick. The dome is pressed up in three heats, then turned on the flange and a final heat and press operation brings it to the curvature of the boiler barrel. The standard flange is 52 inches diameter finished.

In Fig. 10 are shown a hip, a throat and a tube sheet ready for assembling.

Figs. 11 and 12 show two views of a partly completed E. 3. A. standard Atlantic type passenger engine. In Fig. 11 the old-style three-piece dome is shown, also the position of the hip sheet where it joins the roof sheet.

In Fig. 12 the position of the throat sheet is shown. This is a rather uncommon view. It shows the roof-sheet boxes and back head channels for fastening the head stays.

Fig. 13 shows a pile of dies in the yard.

On either side may be seen the supports for the overhead crane. At the back is the boiler shop, which has a swinging door clear across the end to permit the traveling crane to run out into the yard for dies or material.

The average time necessary to build a locomotive boiler in this shop is 15 days, and for a new type about 30 days.

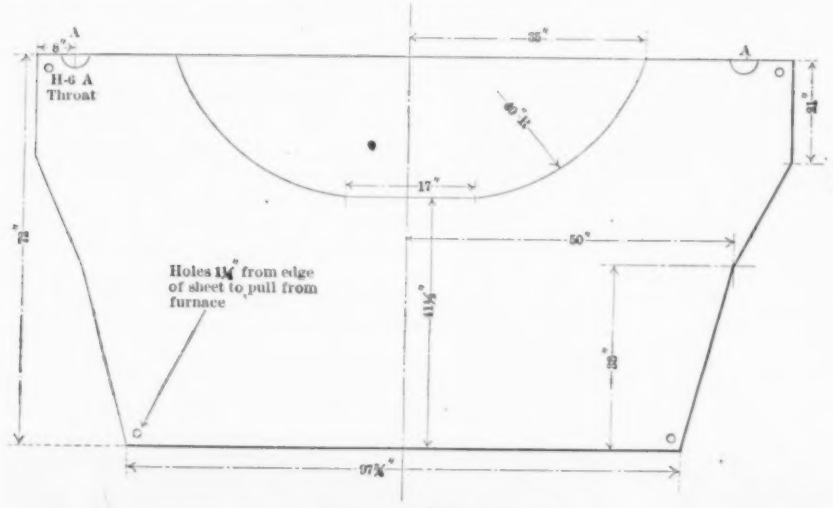


FIG. 9. THROAT-SHEET BLANK

FIG. 10. TUBE-HIP AND THROAT SHEETS, STANDARD ATLANTIC TYPE PASSENGER ENGINE

A funny thing happened the morning after I arrived in Altoona. The afternoon before I had obtained my pass to visit the Juniata shops. Before going further, I may say I am not very familiar with railroad terms. When I came down to breakfast I sat at the same table with a man who subsequently turned out to be a locomotive engineer.

"How far is it to the Juniata shops?" I inquired.

"About ten or fifteen minutes in the trolley," he replied.

"I'm going out there to see the flanging machine," I remarked.

"Oh, you mean the *flanger;* we don't call it a flanging machine. I had it out last winter."

"Had it *out!* What does he mean? Is it a little dinky tool they put on a handcar to bend angle irons and such stuff?" I thought; and then said:

"You had it out? Then you can tell me how they keep the plates from buckling?"

"That's easy. They have springs behind them."

"Just like any other drawing operation," I ventured, "the same as drawing up a can lid, for instance."

"I don't know nothin' about 'can lids,' but it just scrapes the ice and snow about an inch and a half below the tops of the flanges. When the pressure gets too great the springs behind the plates give 'em a chance to relieve 'emselves," said he, eyeing me as though I was a mild lunatic.

He was talking of some kind of a snow plow while I was thinking of the boiler-plate flanger. I didn't offer any explanation, but I caught him glancing sideways at me several times during breakfast, as though he expected me to break out again.

Credit Where It Is Due

By I. B. Rich

Al Freeman, one of my shopmates, invented a new valve motion some years ago. It was an arrangement that located itself almost anywhere between the eccentric and the valve, and which gave the valve a wonderful movement. He said "'twas all in the *dwell* of the valve."

'Twas rather ingenious on the whole, for with a little gear or two he made the valve forget all about the eccentric that was driving it and move just as he wanted it to do.

This "dwell" necessitated a quick movement at other parts of the travel to make up for lost time, and prevent getting left altogether, but only gave him just what he wanted—opened the valve like a shot and closed it in about the same way. The "dwell" kept it open until the proper time for closing, and then it shut with a bang.

First one he made was put on a locomotive, and before doing this he took cards from the engine just as she was. If you're familiar with locomotive cards, you know they look more like a sweet potato than anything else. So he was delighted to find he could get that acme of indication, "a Corliss card." The coal he saved (on paper) would run the road for several weeks, but, of course, all inventors are enthusiastic.

Where the Saving Came In

As a matter of fact he did save a little fuel. We couldn't find a loophole in the reports, and had just about concluded to admit that he might know a thing or two in the valve-gear line, when it broke down. No fault of the gear, but a tooth in the pinion got discouraged and struck, so the whole thing called a lockout.

While 'twas being fixed the engine ran with the regular link, and we naturally wondered how much the coal record would jump. Well, it didn't jump at all—couldn't tell any difference without chasing decimals to the fourth place, and that doesn't pay in such a case. Yet there was a saving over the engine before the change.

Finally one of us woke up to the fact that in applying the new valve gear he had also used a new cylinder and valve. The valve was long, really two valves, one for each end of the cylinder. This made a long steam chest and the ports were short and straight into the cylinder; here was evidently the cause of the saving rather than the valve gear. Short, direct ports, with a consequent reduction in clearance made the difference, and we had been giving the credit all to that "dwell" of the valve.

There's many another case where we fool ourselves and others by making more than one change at a time, and giving credit to the wrong thing.

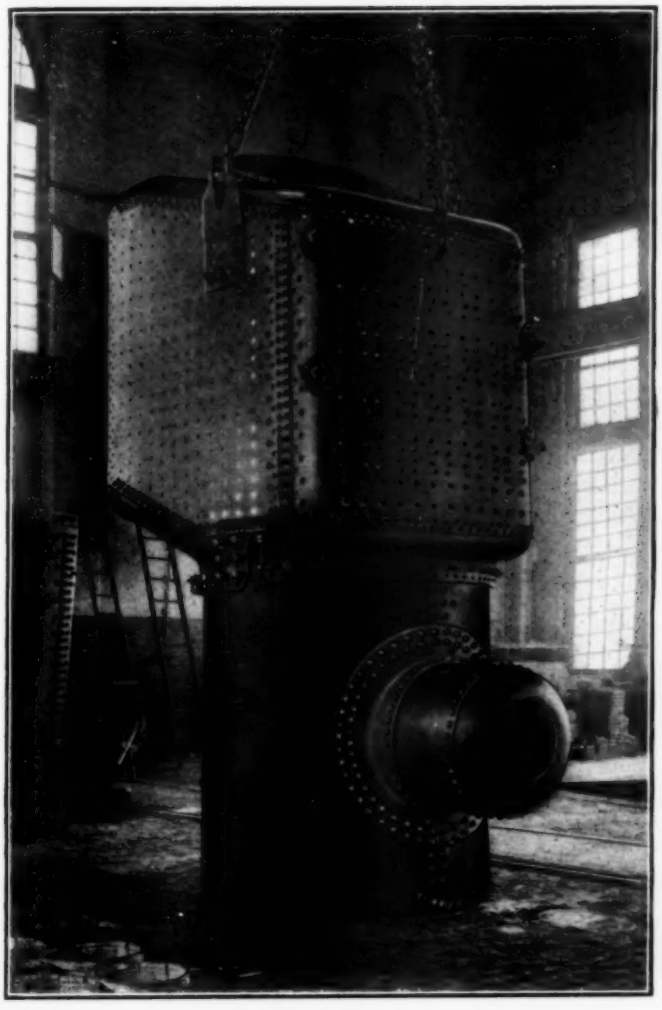


FIG. 11. PARTLY FINISHED BOILER

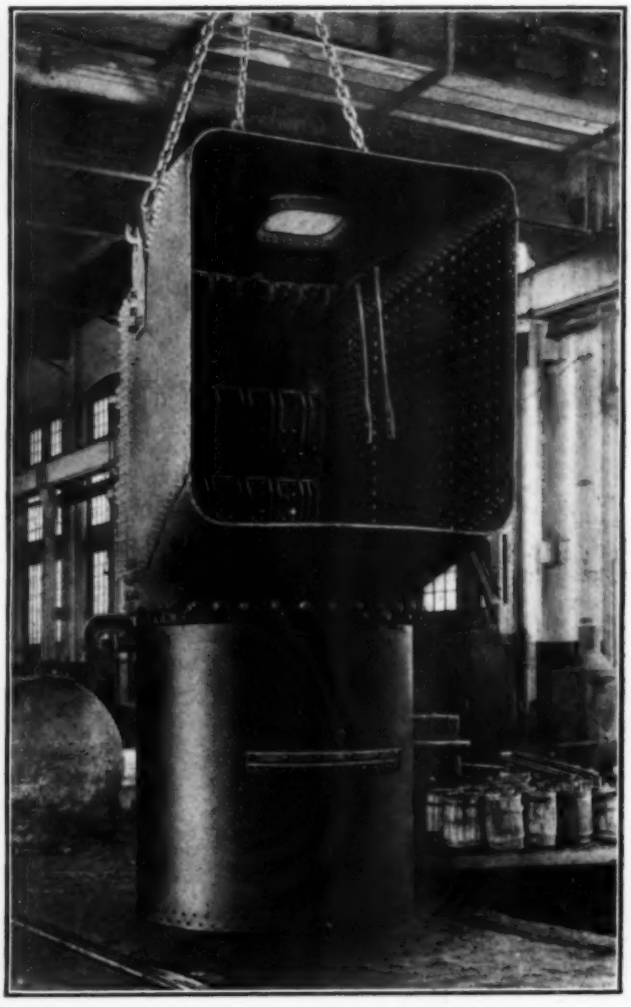


FIG. 12. INTERIOR VIEW OF PARTLY FINISHED BOILER

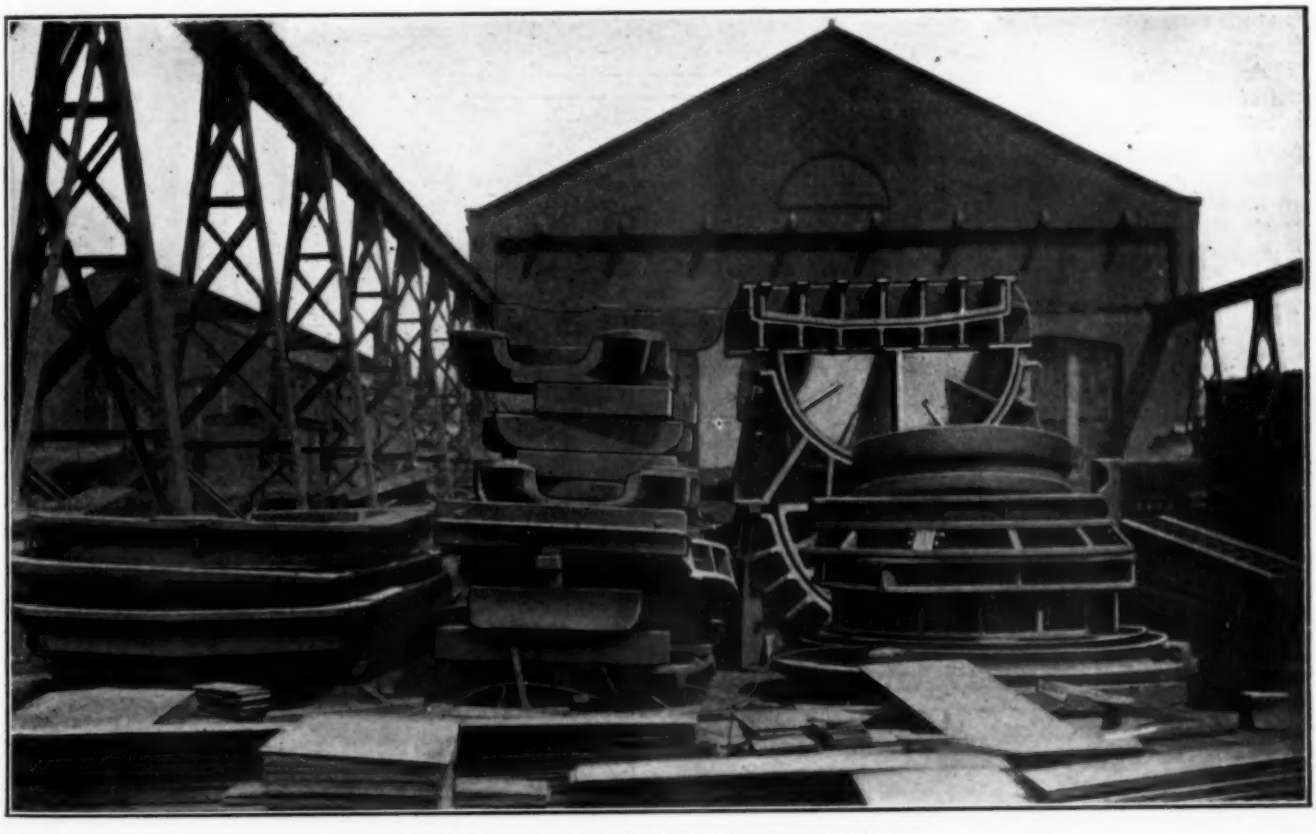


FIG. 13. THE DIES AND THE END OF THE BOILER SHOP

Making a Dial Measuring Machine

The Growth of the Idea, the Details of Construction and the Method of Using This Type of Instrument

BY OSCAR E. PERRIGO.

There has never been a time in the history of mechanical operations when accurate workmanship was in as general or as urgent demand as at present. Much of the work which, even ten years ago, was classed as accurate, the fitting of which was considered almost perfect, would now be condemned by a large majority of inspectors. There were, of course, accurate workmen, and accurate work, because for many years the necessity for accuracy had existed, but only to a comparatively limited extent and confined principally to a few classes of work.

The introduction of interchangeable work almost revolutionized conditions in many respects, particularly as regards accuracy of work. Now more than ever there is an increasing demand, and a broadening of the scope where accurate work is considered necessary. With this demand came, as a matter of natural course, the necessity for better tools for measurement and inspection.

In a Boston shop, in 1866, there was made a lot of dial gages, so called, although more properly, measuring machines. They were of a vertical type, about six inches high, the frame, by its form, reminding one of a diminutive steam hammer. A vertical plunger had attached to it a very small chain of the form used in early watches, called the "chain and fusee system." The opposite end of this chain was attached to a small cylinder, whose shaft carried an index pointer traveling over a dial about the size of a gentleman's watch dial, and graduated in one hundred divisions, each revolution of the pointer representing a plunger movement of a tenth of an inch. A spiral spring kept the chain always taut. This device was considered a fine piece of mechanism.

A small caliper gage, having a system of multiplying levers, was supposed to divide an inch into twenty-five hundred parts. For convenience, in shop parlance one of these was called "the five hundred gage" and the other "the twenty-five hundred gage," the former being used for lengths, exclusively, and the latter for diameters of watch work. It is very doubtful if either of these gages was correct, as there were several conditions which rendered their accuracy almost impossible; certain it is that the caliper gage, with its jaws in the form of the blacksmith's "pick-up" tongs and its system of multiplying levers, could not measure accurately when applied to considerably varying diameters. However, "they served their day and generation," and were a great improvement upon the former appliances for the purpose.

The Advent of the Micrometer

The continued and ever increasing demand for accuracy brought us the micrometer, the pride of every good machinist and practically indispensable to the toolmaker, while likewise a necessity to the inspector. Plug and ring gages, limit gages, and a large variety of similar tools have been supplied, both for the workman and the inspector, but the micrometer still holds its place.

The successful use of the micrometer or any similar gage requires ability, experience and careful handling. It is not always the best tool to put in the hands of the employees of a large inspecting room in which great numbers of duplicate parts must be inspected for very accurate work; not only because it will not bear careless handling, but because it is too slow. The limit gage can be often used, but this only tells us what pieces to pass and what ones to reject; it does not tell the amount of the variation.

To meet these conditions the measuring machine herein illustrated and described was designed and built, and later improved. It is very successfully used, even by comparatively inexperienced operators.

In the accompanying illustrations, Fig. 1 is a front; Fig. 2 a head-end, and Fig. 3 a tail-end elevation. Fig. 4 is a vertical section through the dial case, showing the operative mechanism of the headstock. Fig. 5 is a plan view of the same, and Fig. 6 is a section through the tail spindle, showing its related parts.

Made in Lathe-bed Form

As will be seen by the first three figures, the machine is in the general form of a lathe, with a bed *A* of rectangular, box form, 4½ inches wide, 5 inches deep and 24 inches long. The sides, top and bottom are of a uniform thickness of ¾ inch. The side members are tied by two cross braces *a a*, ¾ inch thick. The top member is slotted to receive the holding-down bolts of the headstock and tailstock, and the bottom member is slotted between the ends and cross braces. This design is for the purpose of equalizing strains as much as possible. The bed is supported on three points by adjustable screws *b b c*, the two former passing through the front support *B*, under the headstock, and the latter through the tail-end support *C*.

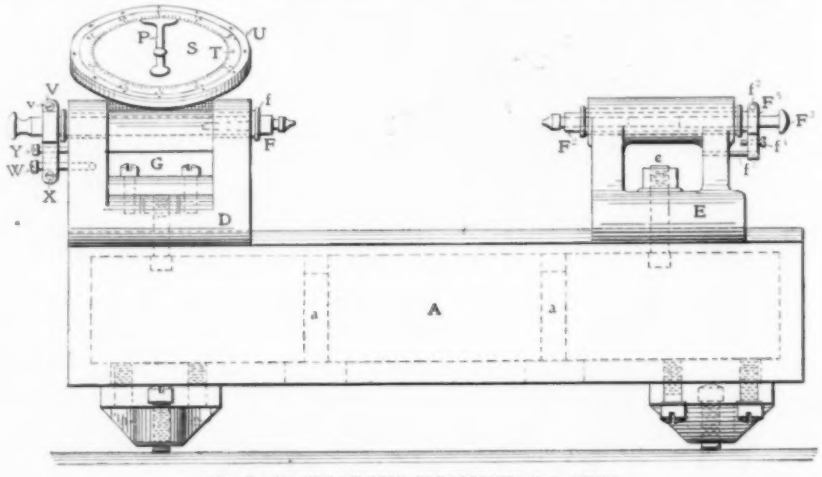


FIG. 1. FRONT OF DIAL MEASURING MACHINE

Each is fixed to the under side of the bed *A* by screws, as shown.

The headstock *D* and the tailstock *E* are fitted to V-surfaces of 45 degrees angle, and ⅝ inch wide at the front and back, and the same width at each side on the horizontal surface of the bed. The headstock is clamped in a fixed position by the T-head bolt, as shown, and the tailstock by a similar bolt, whose nut is provided with an operating handle, projecting to the rear so as to be out of the way of the operator.

The headstock *D* is 6 inches long, and the center of the spindle is 3½ inches above the bed. The spindle *F* is ⅝ inch in diameter, accurately ground, and fitted in split bushings *f f*, which are in turn fitted to taper, tapped holes in the headstock housings. This construction insures not only a good fit, but correct alinement at all times. Fixed to the headstock between the front and rear housings

is the bracket G, which supports the dial and forms a space which contains the operative mechanism for actuating the index arm.

This mechanism is shown in detail in the vertical section in Fig. 4, and in plan in Fig. 5, and consists essentially of a sliding spindle, two cylinders and a segment, all connected by two pairs of steel ribbons, from 0.003 to 0.004 thick and from 0.10 to 0.12 wide. The members of each pair are fixed at one end to the cylinder and wound partially around it, in opposite directions, and the free ends are adjustably connected with the sliding spindle or the segment, as the case may be.

How the Index Arm Works

In applying this principle of transmitting the movement of the main spindle to the index arm, the construction is as follows: A portion of the sliding spindle F is cut away, leaving a flat surface 0.30 wide. Separated from this surface by 0.005 is the cylinder H, formed upon a shaft having upper and lower pivot bearings constructed similar to those in a watch, passing through hardened plates $h\,h$, and their points resting against hardened plugs $i\,i$, these being analogous to the "open jewel" and "end stone" of the watch. These bearing surfaces, as well as the surface of the cylinder, are all ground and lapped very accurately and so fitted that there is no lost motion in a lateral direction, and a very slight end play.

As the sliding movement of the spindle is only a tenth of an inch, the inner ends of the steel ribbons pass less than halfway around the cylinder H, and are fixed to it by being pinned and soldered. The free end of one ribbon is fixed to the spindle by the screw j, while the free end of the other ribbon is similarly fixed to the adjustable block L, which is held in place by the clamping screw l. This provides for keeping these ribbons always taut. The cylinder N is provided with two steel ribbons similar to those on the cylinder H, and similarly connected, except that their inner ends pass each other, thereby adapting this cylinder to make a complete revolution. The inner ends are also fastened in a slight depression, the exact depth of the thickness of the ribbon, so that, as the cylinder is rotated through a complete revolution, the inner end of the ribbon, where it is fastened, will produce no enlargement of diameter of the cylinder, which would affect the accuracy of the measurement. The outer ends of these ribbons are attached to the adjusting arms $Q\,Q$ by a screw, as shown. Each of these arms is attached to the segment M by a screw and a pin at $m\,m$, and is provided with adjusting screws $q\,q$, by which the tension on the steel ribbons is maintained and the position of the index arm P adjusted as required by its proper relation to the graduations of the dial.

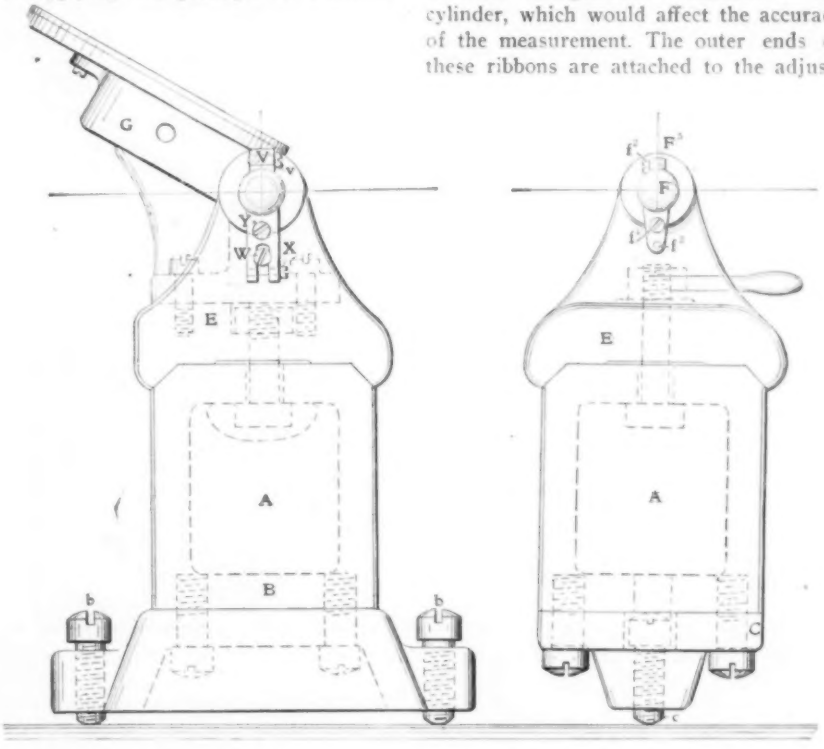


FIG. 2. HEAD ELEVATION

FIG. 3. TAIL ELEVATION

Construction of the Bearings

The lower bearing of the shaft of the cylinder N is of the same construction as that of the cylinder H, while the upper bearing is similar, excepting that there is no thrust plug, as the shaft must project upward through the plate far enough to receive the index arm P.

The casing which contains the operative parts of the measuring device, and which is formed integral with the bracket G, furnishes support for the lower bearings of the shafts of the cylinders H and N. This casing is covered by the plate R, which furnishes support for the upper bearings of these shafts, and also for the plate S and the graduated ring T, resting upon it. This ring is considerably thicker than the index arm P, which is so located that the upper surfaces of both are on the same level, the graduated end of the index arm swinging as closely to the inside of the graduated ring as possible. Both the ring T and the plate S are held in place by the ring U, properly secured to the plate R by twelve screws. The index arm P is secured to the shaft of the cylinder N by means of a hub p, which is "staked" into the arm and forced upon the shaft. This index arm is preferably made of aluminum, as it was found that when made of brass its greater momentum caused it to swing past the proper graduation when the machine was used somewhat rapidly, so that the operator was liable to read it incorrectly.

The cylinder H has a circumference of 1.20 inches, and therefore moves through an arc of 30 degrees, or one-twelfth of a revolution, while the spindle F moves one-tenth of an inch. The segment M, fixed upon the shaft of the cylinder H, has a radius of twelve times the radius of the cylinder N, formed upon the shaft which carries the index arm P; in consequence of this ratio the cylinder N makes one complete revolution, while the spindle F travels one-tenth of an inch. As the dial is graduated in one hundred divisions, each division represents one-thousandth of an inch. Upon the end of the index arm P is a vernier scale by which tenths of a thousandth are easily read. The relative positions to each other of the zero points on the dial and on the vernier are adjusted by the screws $q\,q$ on the adjusting arms $Q\,Q$.

The Spindle Travel

Upon the spindle F, as shown in Fig. 5, is the helical spring K, between the rear housing of the headstock and the clamp collar k. Its purpose is to force the spindle forward to the limit of its travel. Referring to Figs. 1 and 2, it will be seen that the rear end of this spindle has formed upon it a knob for convenient handling, and that between it and the headstock is the clamp V, whose slotted upper end is clamped by the screw v, and whose lower end is slotted and slides upon a cheek screw W, tapped very tightly into the headstock. Its purpose is not only to prevent the spindle from turning in its bearings, but to prevent it from being drawn back beyond its proper limit. The slotted portion of the clamp V is held in contact with the screw W by the clamp screw X. To prevent the spindle being forced forward beyond its limit, the stop screw Y is provided. This also acts as an adjusting screw for bringing the index arm P to its proper position, after its

relation to the dial graduation has been set by the adjusting screws *q q*.

Referring to Figs. 1 and 3, the tailstock *E* will be seen to be somewhat like the tailstock of a lathe, with the difference that its spindle F^2 slides in split bushings tapped into taper holes, so as to insure a good fit and correct alinement; and that no means is provided for clamping it. Both the head spindle *F* and the tail spindle F^2 are drilled and taper reamed for centers, which are very carefully fitted, their front ends turned down to an eighth of an inch diameter, hardened, and the face very carefully lapped to as nearly absolute right angles to the center line as possible.

Instead of there being a thumb knob formed on the rear end of the tail spindle, it is drilled and reamed and a plunger F^3 fitted to it. The end of this plunger is turned down so as to accommodate a helical spring F^4, whose movement is limited by a pin f^6 working in a slot in the spindle. The purpose of this construction is to relieve any undue pressure from the hand of the operator when using the machine. The spindle is provided with a clamp F^5, secured by a screw f^5, and in its lower end is fixed a rod f^3, which slides freely through a hole in the tailstock, for the purpose of preventing the spindle from rotating. The limit of forward travel of the spindle is regulated by the screw f^4, tapped through the clamp F^5.

How It Is Used

In the use of this device, it is necessary to set the two measuring points (or "centers") at a distance apart of somewhat less than a tenth of an inch short of the article to be measured, a fixed length, or an adjustable rod, made for that purpose In doing this, the tail spindle is pushed forward until stopped by the screw *f*. In practice the adjustment should be so made that when an article of the exact dimension is placed between the measuring points and the tail spindle forced forward to the limit permitted by the screw f^4, the index arm *P* will stand exactly at zero. Then when any article measures too short the index arm will stand to the left of zero, and when too long, it will stand to the right of it. This renders reading quick and certain. This is its principal use as a testing machine in the inspecting room, and the regular graduations, as shown on the ring *T* are as well adapted for it as though they were made to the right and left of zero, while it is better adapted for tool-room work.

Specially constructed rests of proper form should be fixed to the bed for supporting many kinds of articles to be measured, and as little strain as possible should be put upon the measuring points or centers.

In use the article is placed between the measuring points with the left hand; with the right at the knob F^3, the tail spindle is forced forward until stopped by the screw f^4. The spring F^4 being of greater resistance than the spring *K*, the main spindle *F* is forced back, and the index arm *P*, actuated by the operating mechanism heretofore described, indicates the exact dimension desired.

When this tailstock was first constructed, the spindle was made solid with a knob formed on its rear end similar to that on the headstock spindle. It was soon found, however, that the varying pressure of the hand of the operator rendered the machine unreliable; hence the sliding plunger and spring were adopted, which corrected the difficulty.

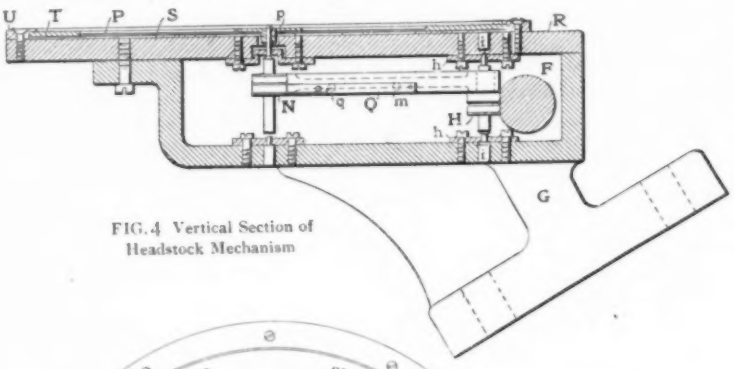


FIG. 4 Vertical Section of Headstock Mechanism

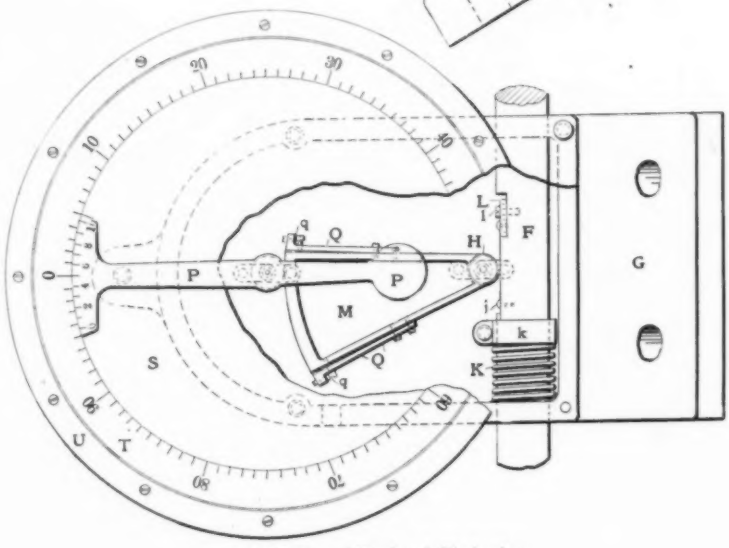


FIG. 5 Plan of Headstock Mechanism

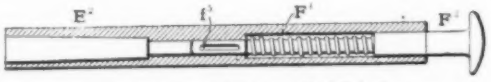


FIG. 6 Enlarged Section of Tail Spindle

DETAILS OF THE DIAL

With this machine an expert operator can measure such articles as small machine parts almost as fast as they can be picked up and laid down, easily separating them into those that are close enough to the required dimension to pass inspection, those which are too small or too large to be useful and those which may be corrected so as to be useful.

For this and many similar purposes this machine was very successful, while as a bench measuring machine in the tool room, one of them not only proved very convenient and quick, but very accurate and reliable.

It is well known that India rubber is largely adulterated in the process of manufacture, but it has been hitherto supposed that the rubber was absolutely pure when it left Brazil. This, however, a writer in *Smith's Weekly* points out, is a mistake, for the Brazilian natives are experts in faking. "It is with the darker or inferior rubbers," he says, "that the Indians mostly try their tricks. When they tap the raw material from the trees, they have ready a good fire and a large bamboo rod standing on two trestles on either side of the fire. Then they begin letting the raw rubber juice drop over the center of the bamboo pole, which they slowly turn over the fire. They grind up corn or any white cereal to the fineness of flour, and, while two Indians are turning the bamboo over the fire, a third is busy sprinkling the flour over the inferior rubber, which at the finish turns out exactly like the finest quantity of 'white.'"—*Indian Textile Journal.*

Rubber is made into *hams* by dipping a paddle into the sap and drying it slowly in wood smoke. While it is still "tacky" adulterants are sprinkled on it. The next coat covers them.

Making a Six-throw Crank-shaft Out of a Solid Bar

By John L. Bogert

The year 1908 promises to be a great year among motor builders for six-cylinder engines, and for that reason very many concerns will be seriously considering the question of how best to make a six-throw crank-shaft. Unlike a four-throw or two-throw crank-shaft, whose crank-pins and bearings lie in one plane, a three-throw or six-throw crank-shaft forging must be twisted to obtain the necessary 120-degree angular advance of each crank over its following neighbor. Six-throw crank-shafts are being successfully drop forged, but they require expensive facilities in the way of heavy drop hammers, powerful trimming presses and care in the frequent reheating of the forging before it is finished. Without careful and frequent reheating the forging is liable to fail in the most unexpected manner.

There are a number of first-class concerns in this country whose drop forgings leave little to be desired, but the preliminary expense for break-down, trimming and finishing dies is very great, costing many hundreds of dollars for a single size of six-throw crank-shaft. If a motor builder contemplated making less than 50 motors with six cylinders in any given year, the "die cost" of each crank-shaft forging before an hour's work had been expended might easily exceed $10 per crank-shaft. Motor builders who make several sizes of engine, some two-cylinder, some three-cylinder, many four-cylinder and a few six-cylinder, cannot economically use drop-forged six-throw crank-shafts, but must resort to the hand-forged slab, cutting out the metal between the crank-arms and turning the pins and bearings from square to round.

Cost of Dies

Even so, if a concern contemplates making less than 25 of any one size of six-throw crank-shaft, this process is much cheaper than drop forging. In drop forging there is one serious danger always to be faced: an expensive set of dies may crack at the very first blow of the hammer, and if the dies are made soft enough to insure against such a contingency, the skin of the dies stretches until the forgings increase too much in weight and in all dimensions. A die cost of $20 per forging before any work has been done is utterly uneconomical, and yet such a die cost would obtain in very many cases if lots were limited to, say, 25 forgings. This is true in general, but subject to individual exceptions.

A Novel Crank-shaft

Last winter the writer designed a small six-throw crank-shaft, a drawing of which is here reproduced, and sent blue prints to many of the principal automobile makers in Europe. The well known Darracq Company, of France, adopted it for its six-cylinder cars, and with such indorsement no engineering defense on the writer's part is necessary. However, it may be worth while to point out that the crank-arms, being circular disks, are free from centrifugal components; and because they may be made much thinner than it would be safe to make a rectangular-section crank-arm, it is possible to get longer bearing surfaces on the same length of crank-shaft. Ball-bearing raceways might easily be mounted on any one of the many crank-disks at a small expense.

A Low-cost Crank-shaft

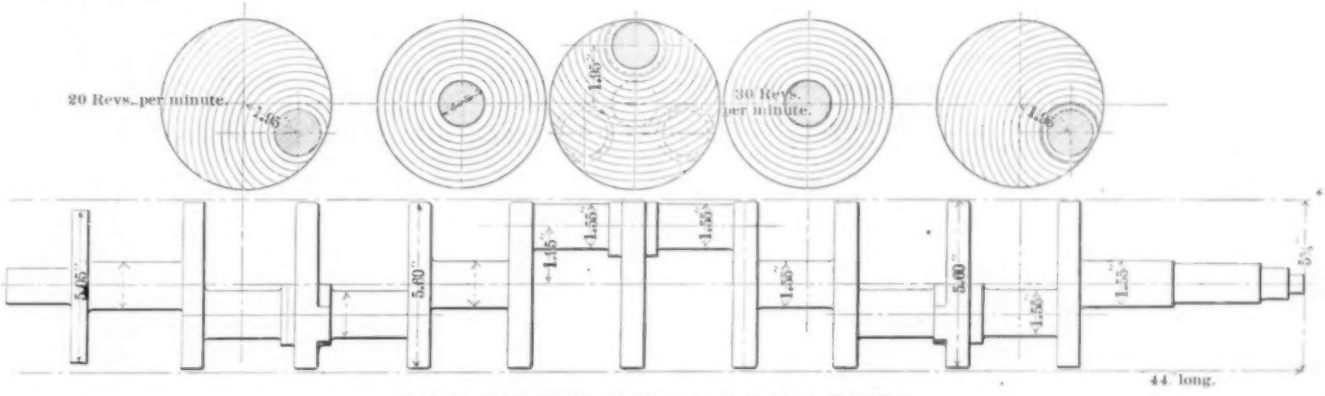
We come now to the cost of manufacture, for this article was written simply to point out how cheaply a six-throw crank-shaft might be made by a shop without steam hammer, drop hammer, forge, press or any of the other accessories of a first-class blacksmith shop. In fact, but one machine tool, a powerful lathe, is absolutely necessary. The bar of steel is 44 inches long, and weighs 330 pounds. Now if this 5¾-inch bar is of the same grade of open-hearth steel as is usually put into the best grade of drop forgings, it will cost $9.90, say $10. You will have to pay 6 cents per pound for 3½ per cent. nickel steel, so that this bar of steel, if of such material, will cost about $20.

Amount of Metal Removed

The number of cubic inches of metal in a solid bar 5¾ inches in diameter and 44 inches long is 1150, as bar sizes usually have a small excess over standard diameters. The number of cubic inches of material that must be cut out of this solid bar to leave the crank-shaft with just enough excess of material for a finish grind is 895, as the cubical content of all the crank-disks, crank-pins and main bearings is 255 cubic inches. It's a poor lathe that will not remove 5 cubic inches of good ordinary open-hearth machinery steel per minute, using any first-class high-speed tool steel, continuous cutting; and thoroughly modern crank-shaft lathes will remove 20 to 30 cubic inches of 0.35 per cent. carbon open-hearth machinery steel, continuous cutting.

Of course it must be borne in mind that when the crank-shaft is revolving around the axes of its crank-pins, it is not a case of continuous cutting, but a case of cutting metal part of the time and air the rest. For that reason, and because the parting cuts or cross-feed cuts close to the different crank-disks cannot be taken as coarse as the turning cuts, it is impossible to hope to realize the speed of stock removal indicated by the above figures. Nevertheless, at $5 per day for a lathe and operative, it would be economical to spend two whole days digging the metal out of the solid bar, as shown, in preference to investing some hundreds of dollars in expensive drop-forge dies.

It ought to be possible to bring the six-throw crank-shaft to the grinding machine with but an excess of 1/32 inch all over its pins and bearings, at a cost not to exceed in the size shown $20, the material being first-class 0.35 per cent. carbon machine steel, acid open hearth.



MAKING A SIX-THROW CRANK-SHAFT FROM THE SOLID

The foreign trade of the United States for the eleven months ended May 31 for the first time passed the $3,000,000,000 mark in such a period and exceeded by $320,351,760 the total for the corresponding months of the prior fiscal year.

The Boston subway cost $2,500,000 per mile.

The Patternmaking of a Locomotive Cylinder

By Jno. W. Wolfenden

In taking up the patternmaking of a locomotive cylinder, as I wish to treat it quite fully, I will begin with the pattern itself. All patternmakers generally make their pattern first, with the necessary core prints and then make the core boxes. However, it is just a matter of choice. In making our last pattern I had three or four core boxes made before starting the pattern.

Referring to the illustrations, Figs. 1 to 4 show the pattern. In Fig. 2, which is a front view, *J* is the exhaust-pipe seat, *K* is the steam-pipe seat, *H* is the saddle flange and *L* is the valve seat. The round part is called the barrel of the cylinder. Other parts will be named as we proceed with the description.

The manner of molding as practised by our foundry foreman, which I believe is universally followed by other foundries over the country, is to cast the cylinder with the saddle flange down, using a three-part flask. The saddle flange is in the drag, the body of the cylinder, including the top half of the barrel, is in the cheek and the lower half of the barrel is in the cope. In other words, the cylinder is cast upside down. We always use a special flask (made of iron) for our cylinder patterns.

I have endeavored to make the drawing of the cylinder as plain as possible, leaving off lugs and ribs, so that the reader will be enabled to understand better the internal arrangement of the steam and exhaust passages. We will take up the core boxes first and explain their construction. Figs. 5 and 6 are views of the steam-supply passage core, which runs from opening *A*, Fig. 1, to the openings *B B*, Fig. 1, branching out over the exhaust-passage core, between points *E* and *F*, Fig. 2. This core straddles the exhaust core at this point and then runs along parallel with said core on both sides until it reaches the valve seat and emerges at the points *B B*. Fig. 15 is a perspective view of the core box for this core, showing the loose pieces removed and in a position on the drawing so that anyone will readily see their position when on the core box.

The part of the core coming between the pieces *A* and *B* is straight. The coremaker strikes it off and smooths it up with his trowel. The pieces *C* and *D* form the neck of the core, which cuts through the saddle and steam-pipe seat or boss.

The core box for the exhaust-passage core, Figs. 7 and 8, is very simple and needs no illustration to show its construction. The core is made in halves and pasted together. It runs from the opening *C* to *D*, Fig. 1. Coming now to the core box for the admission-port cores, Figs. 9 and 10, also *A A* of Fig. 4, we have something a little more difficult to handle. Because the center line of the valve seat is off the center of the bore of the cylinder, it becomes necessary to make a box for each end. The manner of making this box is shown in Fig. 16. The piece *A* is shaped to form the inside round corner. It is held in place by dowels, as shown. The portion of the core between this piece and the point *E* is struck off with a strike, see piece *D*. The concave surface of this strike conforms to the outside circle of the core at this point. For the outside round corner, between points *E* and *F*, I make a strike such as is illustrated by *C*. It will be noticed that on the front part of the box at the point *F* there is a groove. This is about ⅜ inch deep and ¼ inch

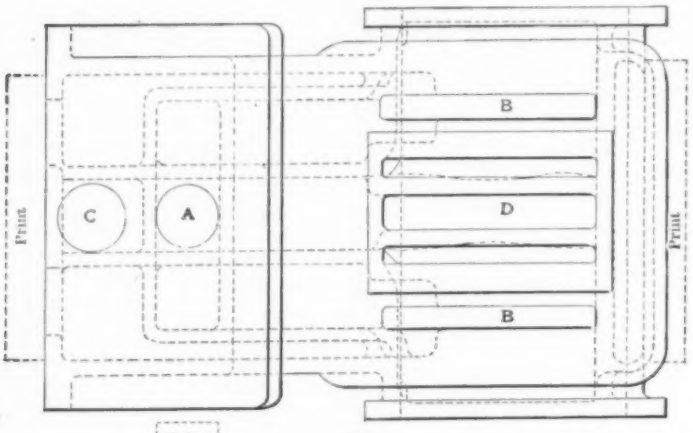


FIG. 1

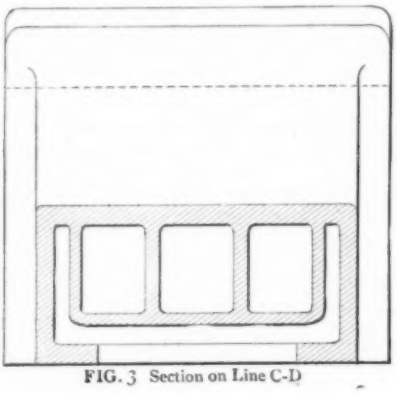


FIG. 3 Section on Line C-D

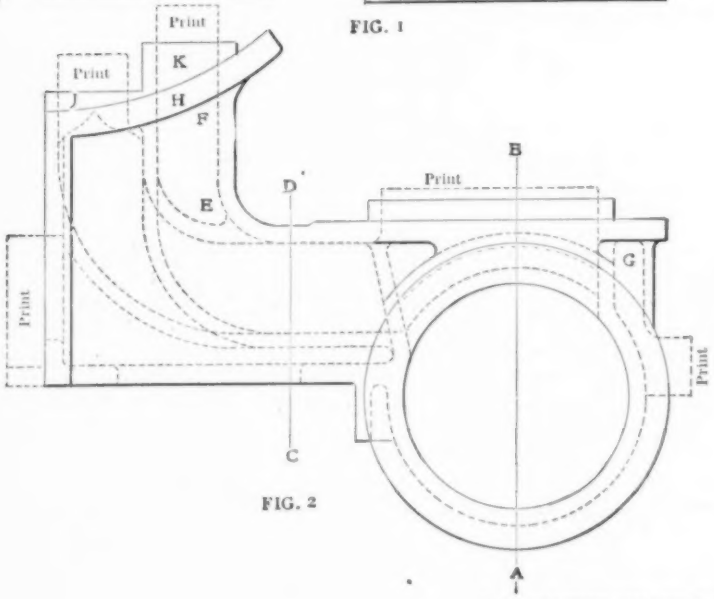


FIG. 2

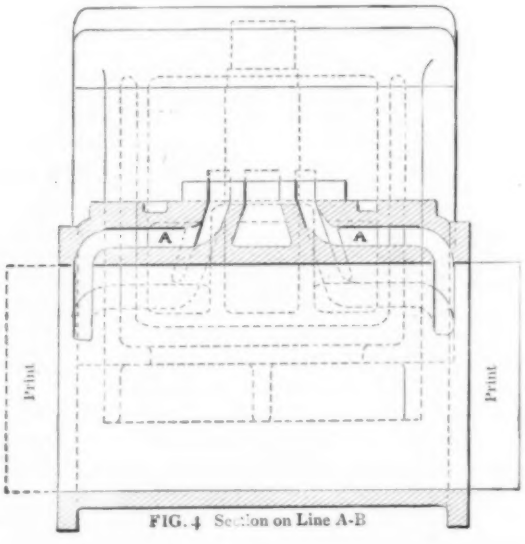


FIG. 4 Section on Line A-B

A LOCOMOTIVE-CYLINDER PATTERN

wide and extends across the front face of the box. This groove is concentric with the circular part of the box as it is turned in it when the end of the box is turned up. The tongue on the strike fits in this groove. The flat part of the strike comes against the front part of the box and the tongue runs in the circular groove. This makes a uniform and true round corner for this part of the core.

Until recently we had been letting the coremaker do the rounding of this corner "by his eye." The results were not of the best. As I had a desire to have this end of the core uniformly rounded both ways, I got up the strike which I have just described.

Fig. 17 is the core box for lightening up the casting at the outside and under the valve seat. The core is shown by Figs. 13 and 14 and its position at *G*, Fig. 2. Figs. 11 and 12 show what we term the bed-plate core. I do not think that it is necessary to illustrate this core box, but will explain how it is made. The parts *A* and *B* are made separately and pasted on. With these parts removed, it will be noticed that the lower surface of the core is straight with the exception of the gap between the print part and the

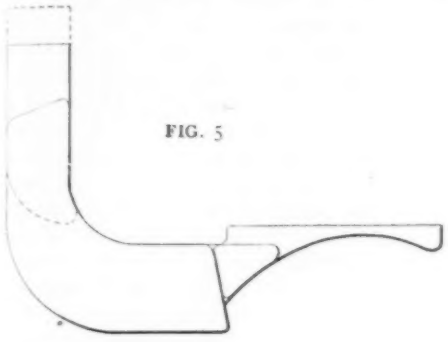


FIG. 5

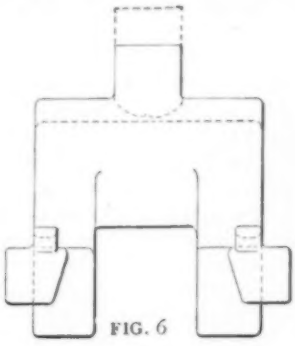


FIG. 6

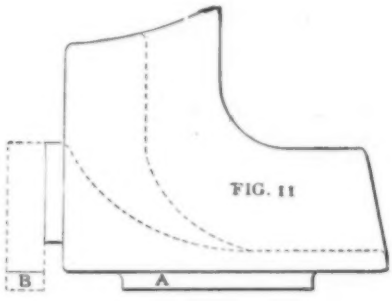


FIG. 11

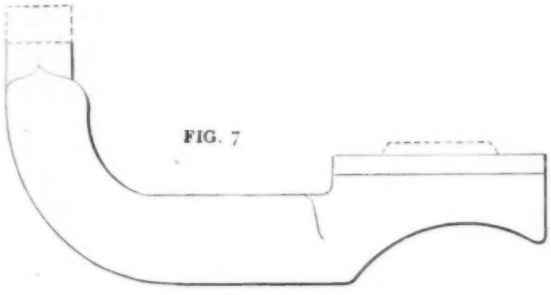


FIG. 7

FIG. 8

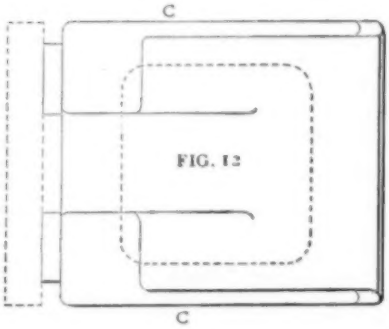


FIG. 12

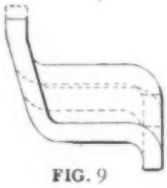


FIG. 9

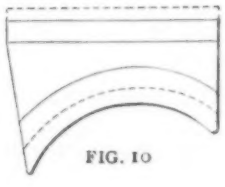


FIG. 10

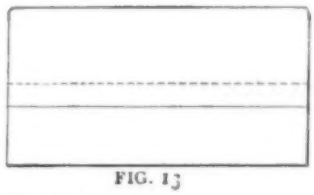


FIG. 13

FIG. 14

LOCOMOTIVE-CYLINDER CORES

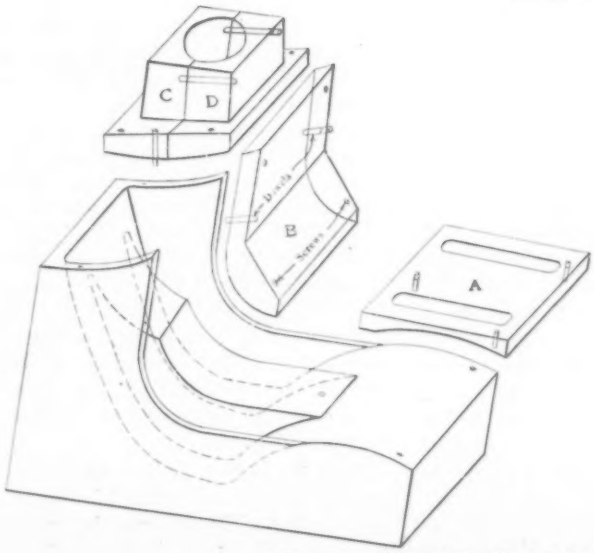


FIG. 15. CORE BOXES FOR A LOCOMOTIVE CYLINDER PATTERN

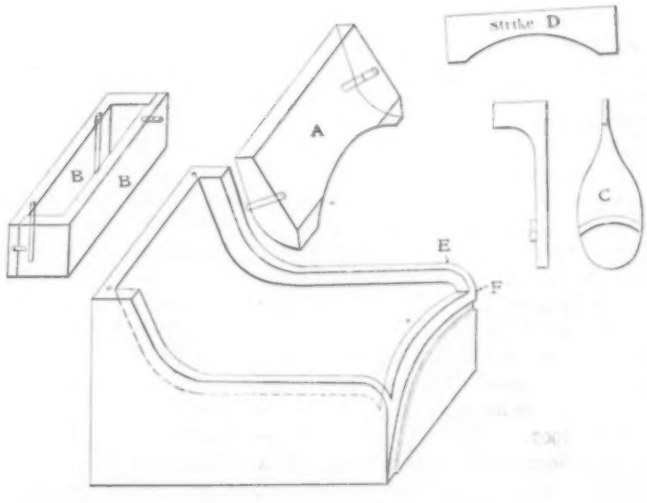


FIG. 16

main body. The piece that forms this gap is put in loose in the box. The box is gained out or recessed in the sides to hold it in the right place. This piece has two openings cut through it, which form the openings through the back wall of the cylinder, and also connect the print part of the core with the main body. Necessarily it has to be in two pieces; the top half is removed before the box is lifted off the core. With the parts *A* and *B* removed, as stated, it will be apparent that this will be the open or top side of the box. As the sides are straight, the next thing to do is to shape out the bottom and forward ends of the box to conform to the shape of the core. The last thing done is to build up a form to the shape of the outside of the steam-supply and exhaust passages and place it in its proper position in this box. It is then complete.

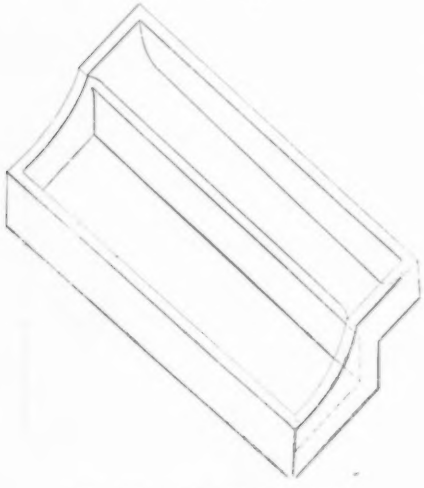


FIG. 17. ANOTHER CORE BOX

In the case of the round core, some prefer to make it of loam on a core barrel. Our foundry foreman prefers, however, to make it in a half-round box, using a cast-iron skeleton for stiffening the core.

In conclusion let me offer a word of advice to those who have never had much experience along this line. Study your drawings well, and get the entire construction of the cylinder firmly fixed in your mind, so that you can see with your mind's eye every nook and corner of the casting before it is cast. The greatest difficulty lies in getting the cores of the proper size and shape, so that there will be the proper thickness of metal between them.

According to a bulletin of the United States Geological Survey, tungsten to the value of $393,667 was produced last year in the United States, for use in the manufacture of steel for high-speed tools. The price has advanced from 30 cents per pound in 1905 to 60 cents per pound in the spring of 1907. Large deposits of tungsten have been found in Australia, and a special investigation has been commenced in this country with a view to locating further deposits here.

Tools for Manufacturing a Locomotive Bell Yoke

By L. E. Salmon

The accompanying line engravings show a locomotive bell yoke and the fixture and small tools used in machining it.

At the time the fixture was made the only machine tool that could be spared was an old Sherman lathe. This, of course, determined the general design of the device. The fixture was also expected to take any size of bell yoke, from the smallest to the largest. To make the subject clear I will give a brief description of the old way of machining them, and then of the fixture and its working. The yoke is shown by Fig. 1. In the old way, when a man got a lot of bell yokes to work up, he started by laying out the three holes, the two in the arms for the trunnions, and the center one for the bell stem. Then he would take them to a lathe, put a drill in the spindle and drill them

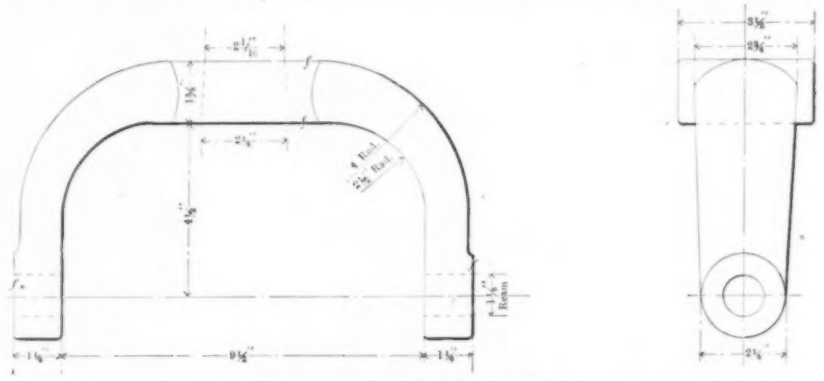


FIG. 1. A LOCOMOTIVE BELL YOKE

on centers. He would then run an alining reamer through the holes in the two arms, put the yoke on a long arbor on which was a facing cutter and hold the yoke against this cutter by means of the carriage of the lathe, until, after numerous trials and measurings, he had taken off sufficient stock. The yoke would then be reversed on the arbor and the operation repeated on the other arm. Next, he would take the yokes to a drill press and swing them from two studs in a double angle iron or knee. Here the center hole was drilled and reamed and the face squared up. Then it was turned up and the hub faced off with a counterbore. The result was that sometimes they came good enough to use and sometimes they were out. The latter was especially true of the workman who happened to run into a large blow-hole.

It will be noticed that the fixture, Figs. 2-4, is made on the principle of a turret, revolving on a hub *M*, Fig. 2, which fits in the cross slide of the lathe. The four holes *m m m m* in the base, Fig. 6, are fitted with tempered tool-steel bushings. They are drilled on a circle 90 degrees apart, and have taper holes which receive the spring lock pin *V*, Fig. 4, located in the upper part of the fixture. This holds the bell yoke so as always to secure a perfect alinement, while drilling and milling the holes and faces; while the T-slot in the base receives a bolt head. This bolt is used to clamp the two parts firmly together.

The plates *A A*, Fig. 3, which the drill bushings *C C* fit into, were made to swing on the tap bolt *x* (a bearing is provided but not shown), so that by removing the slip dowel pins *b b*, they will fall down out of the way while milling the two end hubs. They are replaced to drill by.

The three square-head screws *f f f* are to support the yoke and take the pressure of the two clamping straps *h h*. In order to accommodate larger sizes it will be noticed that there are three more holes *g g g*, farther out, but in the same relative position. After the first yoke is set to the proper hight, these screws do not need to be moved while working on pieces of the same size.

The two nurled hand screws *e e*, Fig. 3, press the yoke into the V-shaped housings in front, which in turn regulate the hight of the end hubs. The V's are central with the spindle of the lathe. It will be seen that the nurled hand screws not only press the yoke into the V's, but also take the strain off the straps when boring and reaming the large hole in the hub

Figs. 7-12 inclusive show the tools used in connection with the fixture, with the exception of a 1 1/16-inch twist drill and a 2-inch flat drill, both of high-speed steel. The cutter holder, Fig. 9, screws on to the nose of the lathe spindle, while the facing cutter, Fig. 10, screws into the other end of this cutter holder. The holder is also bored to receive a No. 4 Morse standard taper-drill shank. Neither the cutter nor the cutter holder has to be removed when not in use, all the other tools fitting into the socket. The cutter is made of machine steel with inserted teeth of high-speed steel, as shown. The blades are held firmly in their places by the taper pins.

When the fixture is in use, the bell yoke is slipped under the straps *h h*, Fig. 3, up into the V's. This insures the two arm hubs coming in line with the spindle. The

large center hub is then brought to the same hight by a surface gage, and the three screws *fff* are screwed up until they just support the yoke at the required hight. Next the two hand screws are brought to bear hard against the back of the yoke. The straps are tightened down and the part is ready for machining. When changing castings after the first one has been set, it is only necessary to loosen the straps and one hand screw. The other one acts as a stop to put the yoke against to secure the correct position.

The first operation is to slip down the two bushings and plates, face off the outside of all three hubs to dimensions, bore and ream the holes in the end hubs and then machine the hole in the center hub, which is reamed with the taper reamer, Fig. 8. The stop is properly set to save tryings. When this is done the boring bar and cutter are put in and the inside face of the center hub cleaned up. The small radius is made at the same time. When the reamer and bar cutter are in use, the bushing *d* is, of course, removed. The three bushings, *d* and *c c* are only used for drilling.

The dimensions to which the yoke is milled are determined by stops on the bed of the lathe. There was at first a slight doubt in the minds of some of my companions about the holes in the arms lining up properly. It was, however, demonstrated that they did line up. We got only one bad one; caused by a big blow-hole. That one was out of line 1/64-inch from arm to arm.

The quickest time made with this fixture was one bell yoke finished every 34 minutes, against 1 hour and 30 minutes the old way. This included changing and measuring. Of course, changing does not take much time, for, after the first one is set, stops locate the others.

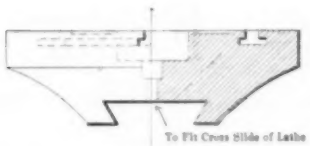


FIG. 5

FIG. 7 Rose Bit
No. 3 Morse Taper Shank

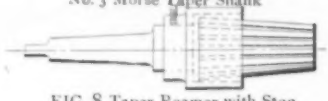


FIG. 8 Taper Reamer with Stop
No. 4 Morse Taper Shank

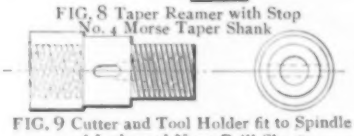


FIG. 9 Cutter and Tool Holder fit to Spindle of Lathe and No. 4 Drill Shank

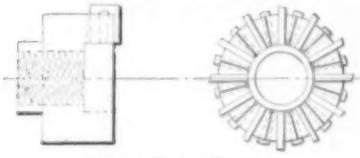


FIG. 10 Facing Cutter

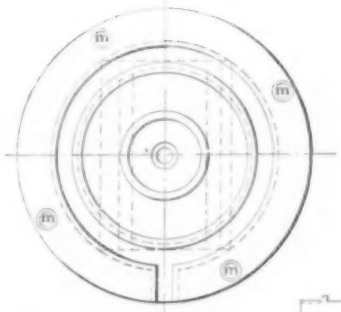


FIG. 6 Jig Base

FIG. 12 Bar Cutter

FIG. 11 Boring Bar
No. 4 Morse Taper Shank

SMALL TOOLS FOR MACHINING A LOCOMOTIVE BELL YOKE

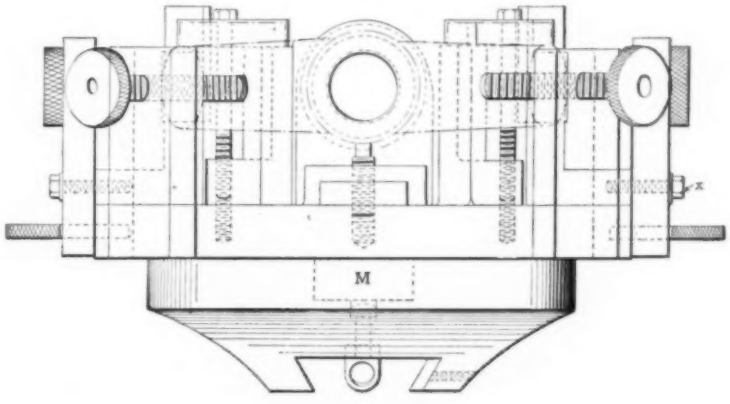


FIG. 2

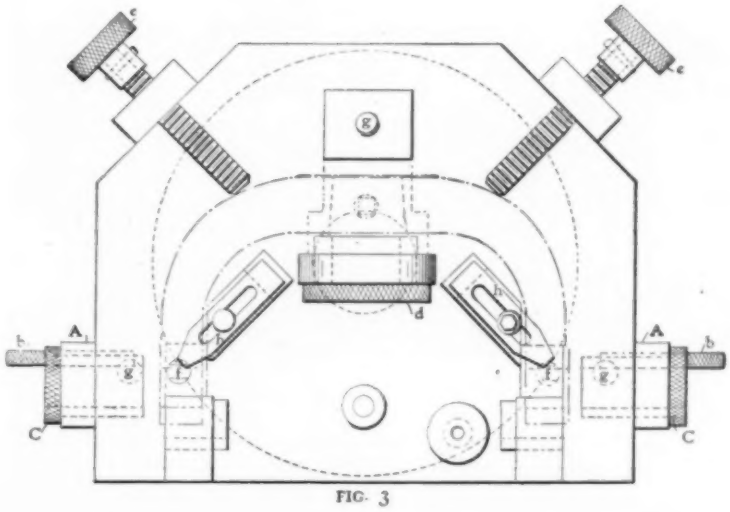


FIG. 3

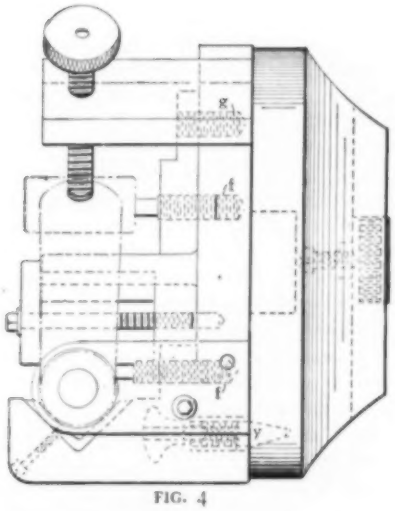


FIG. 4

A FIXTURE FOR MACHINING A LOCOMOTIVE BELL YOKE

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Sectional Sub-press Punch and Die

The accompanying sketch shows a sectional sub-press die very interesting because of the fact that it can be used for many different sizes and shapes by changing different sections on the same punch and die holder. The sketch, Fig. 1, shows a sheet-steel box built up of different-shaped strips, as shown in the details. When it is desirable to produce punchings in great quantities, it is essential that they be accurate in dimensions and in many instances reversible, with perfect alinement. The box shown in the illustration may appear to be unduly light in construction, but it was made so with the object of lessening the cost of handling and settling; so far it has stood its strain satisfactorily.

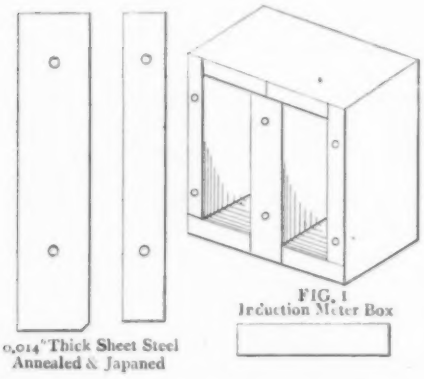


FIG. 1
Induction Meter Box

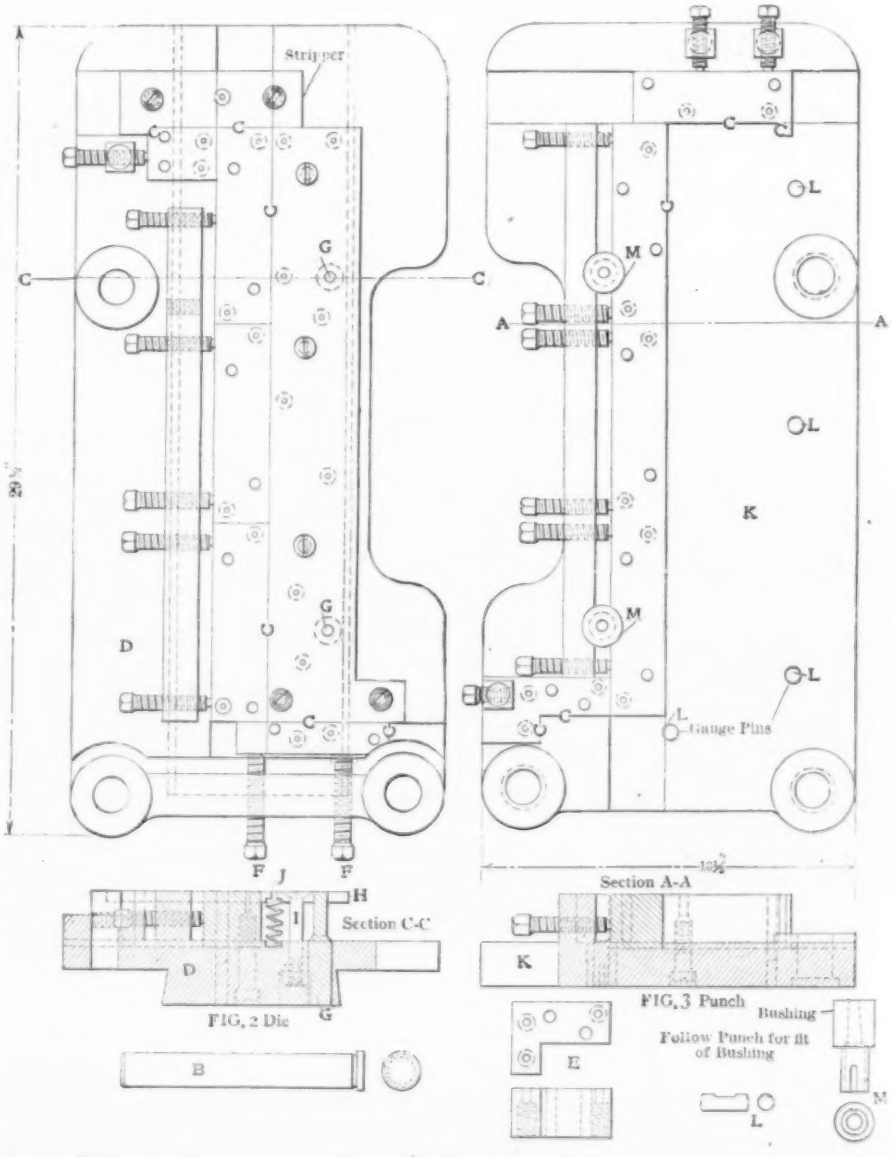
THE PRODUCT OF THE PRESS TOOLS

Fig. 2 shows the die in plan and in section *C C*. The holder *D* is of good close-grained cast iron planed on the bottom and across the three bosses. At the top a recess at right angles to the main groove was cut with a 2-inch end mill on a vertical miller. These grooves are wide enough to accommodate different lengths and shapes. The surface has to be parallel with the bottom; the latter is dovetailed and enters into the gate of the press, gibs being used on each side with adjusting screws to secure it in position for alinement. The three sub-press pins *B* are of tool steel, hardened as far as the head, ground to a light driving fit on the head end, which goes into the punch, and on the other end to a sliding fit in the die holder.

At the top, in the recess of the cast-iron holder *D*, were fastened the sectional parts, of which only one is shown in the detail, Fig. 3. It is made from Firth's No. 6 temper, best P. D. steel, annealed. Each piece is secured from the bottom by screws and two steady pins between, hardened and ground all over. It will be noticed that two small holes are drilled in the center of the screw holes; these are to transfer the screw holes of the sections, after having been hardened and ground, to the cast-iron holder when assembling. Each section is reinforced on the outer side by set-screws *F F*.

Two piercing punches *G* are hardened and ground all over and driven in place, after being located from the templet. The ejecting or stripping device *H* is made in two pieces to fit the cutting edges marked *C*. It is secured by flat-head screws *I* and adjusted by nuts from the bottom of the cast-iron holder. Between the stripper and the holder are placed 13 helical springs *J* to keep the stripper at the proper hight and with the proper resistance.

The cast-iron holder *K*, Fig. 3, is planed on the bottom and across the three bosses. The three holes for the sub-press pins are drilled, reamed and counterbored with the die block after the punch and die are assembled, with a light driving fit for the head end of the sub-press pin. These gage pins *L* on the side, and one on the end, are located according to the length and width of the punchings; they are flat-

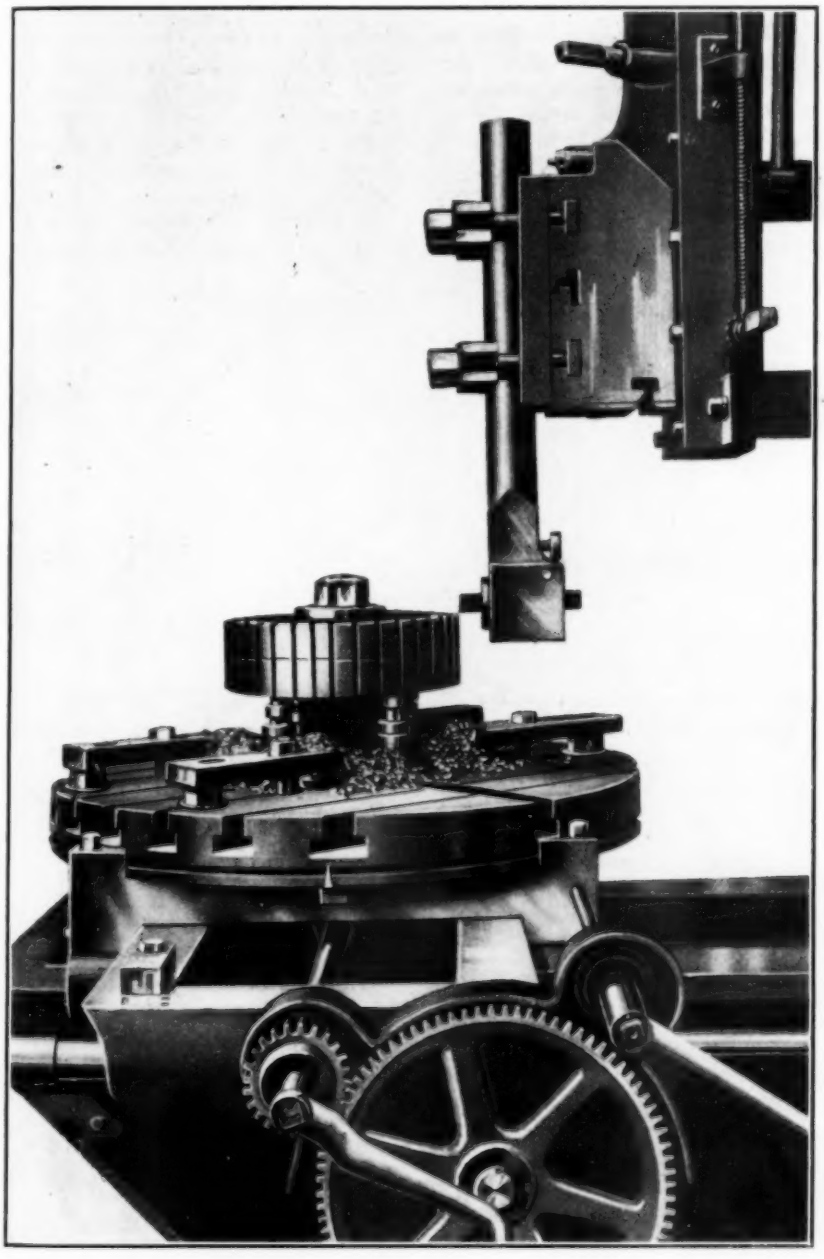


SECTIONAL SUB-PRESS PUNCH AND DIE

tened on one side in the middle (see detail) and held in position by means of a flat key on one side of the hole. A helical spring is located at the bottom of the gage pins; as the die descends or ascends, the gage pins follow to the right hight for gaging the next punching. The punch sections, of which only one *E* is shown in the detail, are made and secured precisely as the die section, only that in locating the positions for the piercing bushing *M* it sometimes happens that the holes for the bushings are too many and so small that they cannot be conveniently bored. The holes are then transferred by a drill that runs through the die and is the same size as the piercing plug, the die being used as a drill jig. After drilling, the holes are counterbored twice to the right size for a driving fit for the piercing bushings. The latter are made of tool steel, hardened and ground all over with a taper of one-half degree in the hole; a straight pin on the bottom end holds it in position while in operation, in case it should work loose. R. A. ALMOND.

Grooving Inserted-tooth Cutter Blanks on the Slotting Machine

We had a number of straddle mills in pairs to make. They ranged from 12 to 18 inches diameter by 3 inches wide.



GROOVING MILLING CUTTERS ON A SLOTTER

As there was only one milling machine available, and the job was in a hurry, I was obliged to make use of an 18-inch Dill slotter. The fixture was made of cast iron with a central stud a snug fit for the blanks. The graduations on the table were used for indexing. I was agreeably surprised to find that the slotter beat the milling machine by over 30 per cent.

M. H. WESTERBROOK.

Standard Proportions of Machine Screws

As a plain mechanic, who has never made machine screws as a business, but who believes he appreciates some of the difficulties of the situation, I cannot refrain from an expression of disappointment at the adoption of still another arbitrary standard. Comparison with the old standards reveals many changes, but most of them so slight as to affect only the third decimal place.

The tables show the expenditure of much time and thought by the committee, but a few questions persistently come to my mind regarding them.

Was a new standard necessary? Would it not have been better to select the best or the most widely used of the older ones and adopted that instead of working up an entirely new one, which is as arbitrary as the others?

Why depart from the wire gage diameters, bad as they are, unless we adopt a rational standard that means something? Would anyone know the difference, without measuring pretty closely between 0.18944 and 0.190, the old and new size for a No. 10 screw and, while the new is better because it is easier to remember, why change for such a small difference?

If it was necessary to have a new standard for diameters, and to maintain approximately the same sizes, why not abandon the old numbers and call each size by its diameter? Then a No. 10 would be No. 190, and if you were asked for a No. 346 you would know it was 346 thousandths of an inch.

As a matter of fact there seems little necessity of going into thousandths at all and hundredths would make a rational base. Then a No. 6 screw would be 0.06 inch in diameter the same as a No. 0 of the new standard, and no one would have any excuse for hunting up a table for anything except the threads; he would know the diameter at once.

Another thing that strikes me as peculiar, to put it mildly, is the carrying of the machine-screw sizes above quarter inch, if above one-eighth. Taking No. 24, we find it 0.372 in diameter, with a 16 thread; three one-thousandths smaller than the ⅜-inch bolt size, and with the same thread. What is the excuse for such a standard size as that?

This is not written for the sake of finding fault with the work done, although it does seem to me like a step away from, rather than toward, a rational standard. I hope practical screw-machine men will give us their ideas on the subject.

JOHN R. GODFREY.

Nature of Contact between Emery Wheel and Cutter Teeth

On page 730, Part 1, J. Edgar writes with the object of proving that a convex relief for a cutter tooth is, when ground with a flat-faced wheel, an impossibility. Mr. Edgar's criticism of my previous article seems to be based upon a misconception as to the nature of the contact between the emery wheel and the cutter tooth. In his sketches Figs. 1, 2 and 3 and the reasoning accompanying them he

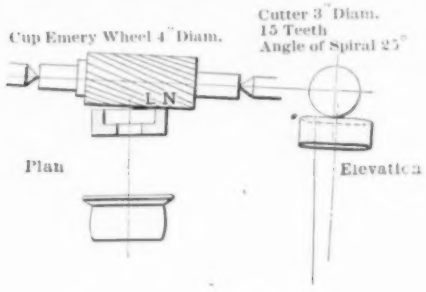


FIG. 1. USING A CUP WHEEL

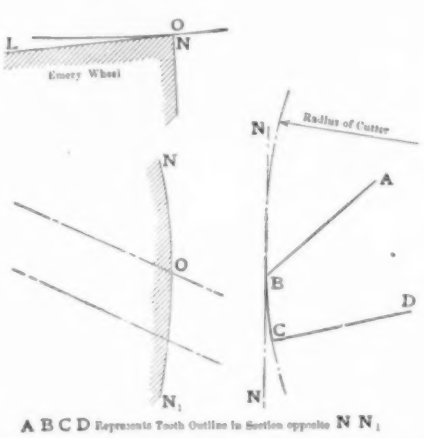
assumes that the emery-wheel face is, in plan, straight and parallel to the cutter center. Afterward he proceeds to show that this is impossible. He then concludes that the contact between the surfaces must be, as viewed in plan, a point. But he neglects the effect of the wear of the emery wheel.

The nature of the contact is perhaps somewhat hard to understand. It depends, however, simply upon the fact that that portion of the emery-wheel face in contact wears. This wear tends to increase the contact, measured along the tooth; also the emery wheel is worn to a curve, as is required through the tooth being a helix. This curve is shown in plan in the accompanying Figs. 2, 3 and 4, which also show the emery wheel in different stages of wear and contact. It should be explained here, to prevent a misconception as to the amount of wear of wheel to secure this contact, that the wear which is shown in dotted lines is quite slight, the distance $Q\,B$ Fig. 4, being really only a little over 1/64 inch. The length of contact there shown is approximately 3/16 inch.

We may now take the case of a new cutter. It has been hardened, ground in the hole, mounted on a mandrel and circular ground to bring all the cutting edges equidistant from the center. At the commencement of the sharpening operation the teeth will be presented to the emery wheel as shown on Figs. 1 and 2, where Fig. 2 is an enlargement of a portion of the emery-wheel face $L\,N$, Fig. 1. The emery wheel is assumed to have a straight face, slightly cupped to prevent the contact assuming greater proportions than are desirable. The contact at commencement will be theoretically a point indicated on Fig. 2 by B. The wear of the emery wheel will not allow this point contact to last, and it grows rapidly into a line, the length of this line contact varying with the grinding conditions—the angle the face $L\,N$ makes with the cutter arms, the hardness of the emery wheel, etc. Fig. 3 indicates approximately the conditions of contact when the sharpening is half completed. Here the line of contact is indicated by $B\,P$, the path of the extremities of the contact line in elevation by the lines $M\,M_1$ and $N\,N_1$. The tooth sections shown have been taken opposite these lines. When the sharpening is completed and only a "hair line" of the circular grinding is left, Fig. 4 shows the conditions of contact. The line of contact $B\,C$ now extends mutually across the tooth relief and the grinding face. Should this line be any other than vertical, the relief will be curved for the reasons which have been explained in the previous article on page 486, Part 1. As in Fig. 3, the lines $M\,M_1$ and $N\,N_1$ represent the paths of the extremities of the grinding line, and the tooth sections $A_1\,B_1\,C_1\,D_1$ and $A\,B\,C\,D$ are taken opposite them. The wear which is assumed to have taken place during the sharpening of the cutter is shown in dotted lines. On Fig. 5 are shown the two sections $A_1\,B_1\,C_1\,D_1$ and $A\,B\,C\,D$, Fig. 4, with an intermediate section still further enlarged taken midway between them.

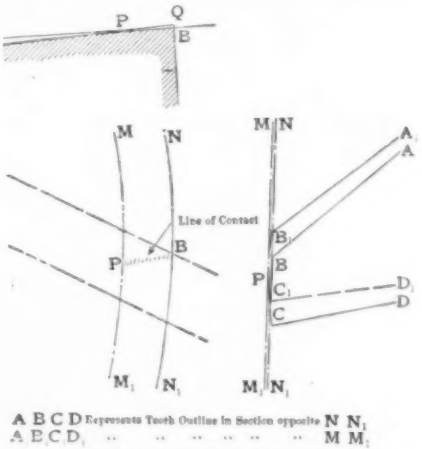
To indicate some of the rather complex features affecting the relief of a cutter tooth, it may be mentioned that though lines $M\,M_1$ and $N\,N_1$ are in end elevation, Figs. 2, 3 and 4, shown as straight, they are not strictly so, this being due to the slight inclination the wheel makes with the cutter axis. The grinding face is not only curved, but the curvature varies throughout its face. The curvature at the point of contact is, however, too small to be detected in such a slight width as the tooth land; being to a wheel of 56 inches diameter at the line $M\,M_1$ and to one of 64 inches diameter for the line $N\,N_1$.

Interference with the succeeding teeth would prohibit the use of a cup wheel,



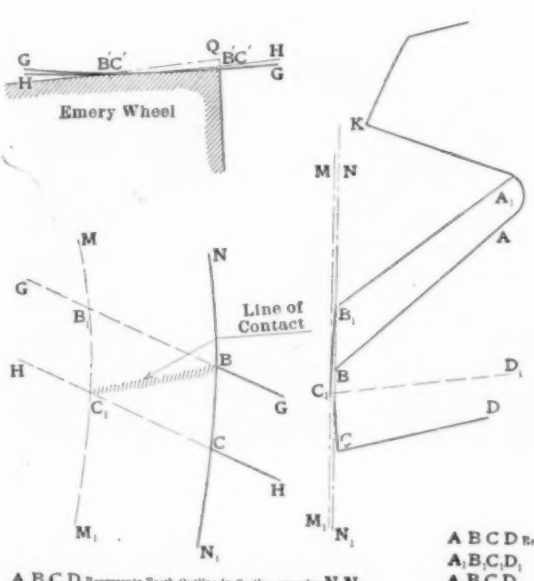
A B C D Represents Tooth Outline in Section opposite N N1

FIG. 2. ENLARGED PORTION OF EMERY WHEEL

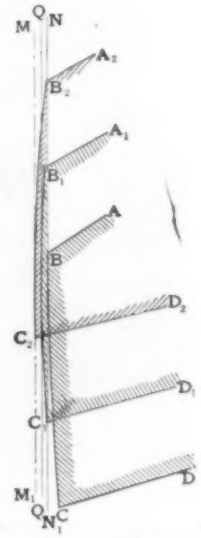


A B C D Represents Tooth Outline in Section opposite N N1
A1 B1 C1 D1 " " " " " " " " M M1

FIG. 3. CONTACT WITH SHARPENING HALF COMPLETED



A B C D Represents Tooth Outline in Section opposite N N1
A1 B1 C1 D1 " " " " " " " " M M1



A B C D Represents Tooth Outline in Section opposite N N1
A1 B1 C1 D1 " " " " " " " " Q Q
A2 B2 C2 D2 " " " " " " " " M M1

FIG. 5

FIG. 4

DIFFERENT POSITIONS OF THE WHEEL

especially with a fine pitch cutter or if much relief were given to the teeth. The emery wheel would grind away the edge *K*, Fig. 4.

H. T. MILLAR.

M——, England.

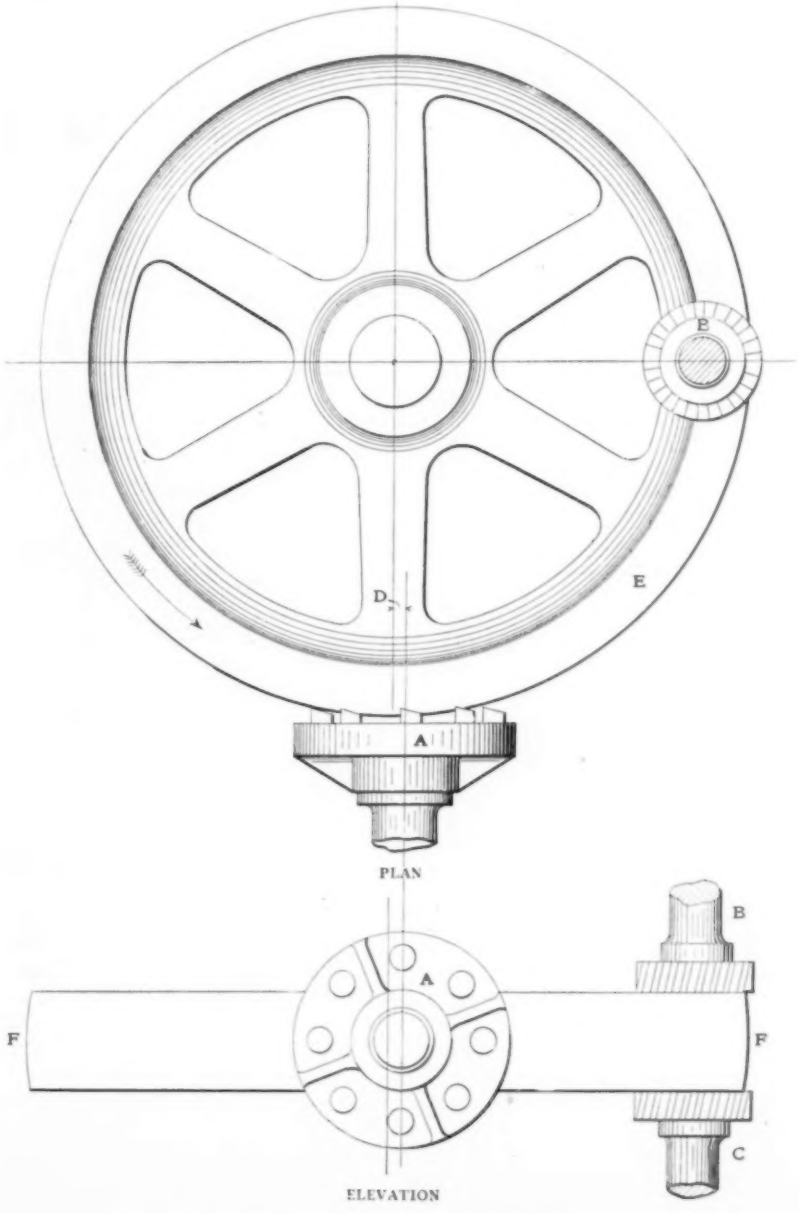
Milling Gas-engine Fly-wheels

At a large gas-engine works where I was formerly employed, I saw a milling operation which struck me as being novel and quite unique—the milling of a gas-engine fly-wheel in the manner shown in the accompanying illustrations. It was done on a machine specially designed for the purpose.

Operating on the rim at the same time were three cutters marked *A*, *B* and *C*, the latter being of the inserted-tooth type, using ⅞-inch round steel cutters. The wheels were clamped on a horizontal table which had a slow, circular motion. The two cutters marked *B* and *C*, operating on the two edges of the periphery *E*, milled the rim to the required width, while *A* milled the *curved* face of the wheel. Any degree of curvature could be obtained by varying the distance *D* between the center of the wheel and the center of the cutter spindle. The cutters operating past the center do not produce a flat face, but a curved surface, as shown at *F* in the elevation.

I do not know how the time compared with that required for turning, but from what I could gather, they were milled in much less time, as all the three surfaces were being operated upon at once.

England. W. D.



MILLING GAS ENGINE FLY-WHEELS

A Use for Tracing Cloth

The suggestions made by E. J. Bartlett, on page 134, in regard to uses, or rather misuses, of tracing cloth are pernicious. Such an employing of this factory material and property is as far from right as the making of shoe strings, "galluses" and apron strings from rawhide belt laces, and cutting off curtain cords to tie up dirty overalls just before quitting time Saturday noon.

Instead of spending effort to make curtains out of tracing cloth, a requisition should have been written for some shades, that is, if they were really needed. Did Mr. Bartlett ever compare the cost per yard of ordinary shade cloth and tracing cloth?

Small pieces which would otherwise go into the waste basket might be used for incandescent-lamp shades; but has Mr. Bartlett never seen a piece of paper or cloth which had been wrapped around an electric light bulb and which was dried and charred and even in a blaze? Of course we do not know the insurance requirements in connection with his plant, but one section of the National Electrical Code of the National Board of Fire Underwriters reads: "The bulb of an incandescent lamp frequently becomes hot enough to ignite paper, cotton, and similar readily ignitable materials, and in order to prevent it from coming in contact with such materials, as well as to prevent it from breakage, every portable lamp should be surrounded with a substantial wire guard."

Tracing cloth should not be used as the article referred to suggests.

P. H. JONES.

Cutting Gear Blanks on the Milling Machine

On page 122, F. T. Schell writes about cutting gear blanks on a milling machine, instead of turning them. While I admit that there are many things that could be done cheaper on a milling machine than in a lathe, yet I can't see where the saving is going to be in the case he mentions.

I don't know just what kind of gear blanks he refers to, but for the sake of illustration, I will imagine they are castings, and have to be bored, each side of the hub faced, and the rim turned. Probably the first operation would be to chuck them by the outside diameter, in a three-jaw chuck, bore the hole, and face the one side of the hub, this being done in a lathe. Then they would have to be put on an arbor to have the other sides faced; so it seems to me to be much quicker to put two on an arbor at a time, with the finished faces of the hubs together, then turn the rims, and face the other side of the hubs on the same lathe.

In this way there would not be any special tools to make, like the fixture illustrated by Mr Schell, and there would be no lost time through the changing from one machine to another. Again, there

would be more or less chatter in the milling machine, owing to the cutting tool being so far away from the point of support of the gear blank, and the rim would not have the smooth finish that can always be obtained in a lathe.

In addition to this, a double-head milling machine is more or less a luxury in machine shops, and it is not every firm which possesses one.

Thus comparing the two machines and the conditions on a job like the one previously mentioned, I can't see where 40 per cent. of the time is going to be saved by the milling machine. I think the lathe has got the milling machine beat in this case, and would like to hear what some of your other readers think about it.

L. CONRAD.

Several Pump Experiences

Recent articles in the AMERICAN MACHINIST on pump experiences recall various experiences of my own and of my friends with pumps, some humorous and some otherwise. One which made me smile was "on" a friend of mine who was thoroughly competent and somewhat conceited.

One winter's morning, when it came time to start the boiler pump, it positively refused to go. A half-day was spent by the engineer and a machinist before it was discovered that the exhaust pipe, where it projected above the roof, had frozen shut due to a leak through the throttle.

Another friend and his mechanical talent spent two or three days' time finding the cause of their failure to get water into the boiler. In this case the pump would run when an outlet was provided for the water. With the check out and the stop valve open, water would flow from the boiler; yet when the piping was connected, it stopped the flow of water entirely. The trouble was that the lock nut holding the disk of the globe stop valve to the stem had unscrewed, thus allowing the disk to act as a reversed check valve; which it did perfectly.

I have always understood that long suction pipes must pitch to the pump, but in piping a 500-foot suction to a pump with a labor boss who was inexperienced in maintaining a grade, I found myself with quite a pronounced hump in the line. It has caused no trouble in six years.

In the growth of the industry in which I am employed it became necessary to provide a larger boiler-feed pump. This was done by overhauling a pump that had been used in pumping gritty water and had been bored out from 6 inches to 6¾ inches. This pump would pump hot water perfectly, but if the heater should by chance become filled with cold water, it would refuse absolutely to throw any whatever. I ascribed this action to the extreme thinness of the cylinder walls (about 5/16 inch), the contraction acting to cause excessive leaking. This may not be the reason, but it is the only one I could give.

We get our water from drilled wells from one hundred to three hundred feet deep. We used to drop a brass cylinder down in the casing, securing it with a packer. After getting two cylinders and a plunger everlastingly fastened in the drive pipe, we discarded this method, and now all our wells have the cylinder attached to a drop pipe inside the drive pipe. In case of trouble we can get all the parts out for repairs or inspection.

I have never seen a cylinder packer that could be unlocked after the sand and sediment had settled around it. The most serious objection I have to the ordinary deep-well pump is its lack of capacity. We have a 10-inch 300-foot well that we believe is good for 25,000 or 30,000 gallons per hour, but from which we can get only 10,000 gallons per hour owing to the capacity of the pump. This has decided us to try the air lift, especially as we are going to need about three times as much water as we have in the past.

J. O. BENEFIEL.

A Broaching Fixture

I have read very often and been told oftener that "there is nothing new under the sun," but even so perhaps my way of making a broaching fixture may be of interest. It was for a great variety of brush-holder body castings, which cannot stand much pressure without being distorted. Their complicated form prohibited the use of a built-up fixture.

The way I have solved this problem, I will describe. As will be seen from the drawing of the parts to be broached, Fig. 1, they are made rights and lefts. The right-hand master pattern was taken, and

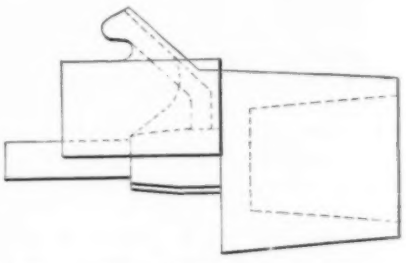


FIG. 2. THE PATTERN FOR THE CHILL

the lugs and pads of the left-hand are put on it, so as to make it both right and left hand. Then the necessary core prints were added.

This made the pattern, Fig. 2, for the chill, which after having been dressed up is ready for the mold. After the pattern for the fixture casting *B*, Fig. 3, has been molded, the chill cast from the pattern, Fig. 2, is inserted in the mold. It is then ready to pour.

After the chill has been driven out of the shell casting, we have the broaching fixture *C*, which only has to be finished at the bottom to be ready for use. It will be easily seen that the inside of the

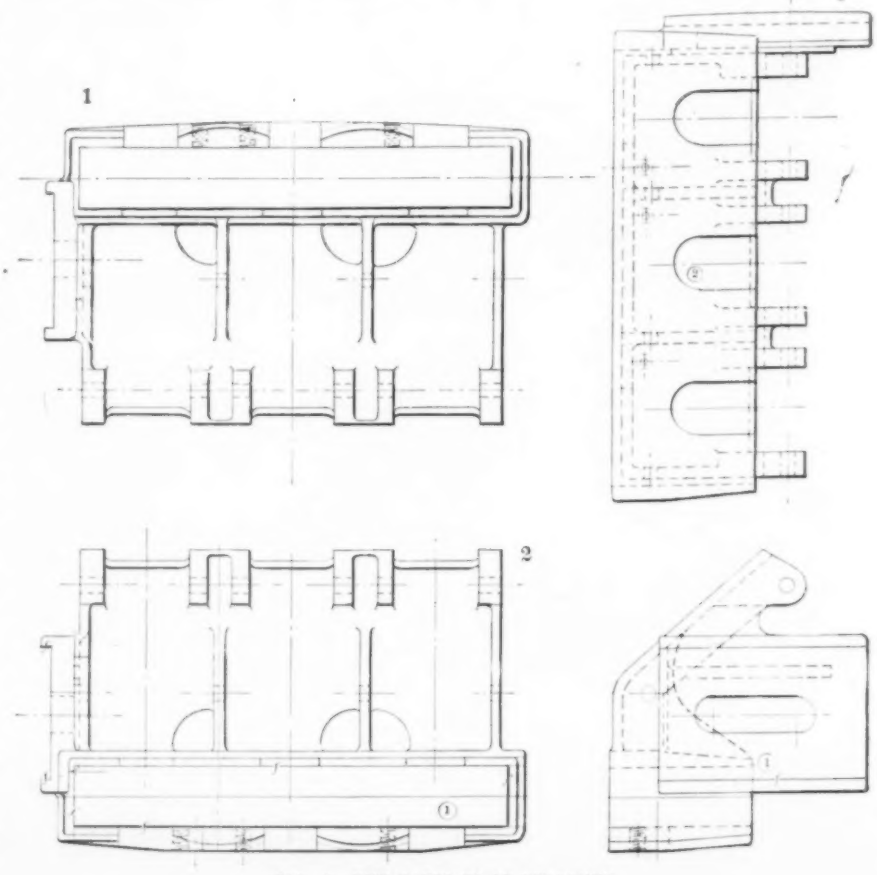


FIG. 1. THE PARTS TO BE BROACHED

fixture has the same contour as the brush holder body castings, and has been obtained at very little cost.

J. G. GOULET.

Indexing System

I do not believe that Wm. E. Reed will get as much satisfaction out of the Indexing System of filing clippings he described on page 75 as he thinks. I have tried envelops and nearly every other system I have heard of but for me they have not proved just right.

Quite often a very valuable article will appear on one side of a sheet and on the other side one still better but on entirely different subjects. The illustrations for both will be on some other page and this occurred so often that I got tired of it.

Now I have several pairs of covers made of cardboard hinged at the back with cloth and just large enough to take in the *Scientific American* without folding, that publication being about the largest.

I take 20 sheets, more or less, making sure that all of the articles are included in this bunch, renumber the sheets with a red pencil, I only number every other page, and bind it with brass eyelets.

They are now ready to be laid just loose between the covers, about 200 sheets or 400 pages being enough for each. They are of course numbered consecutively.

My index is from one volume of AMERICAN MACHINIST and it covers practically everything necessary. I cut between the columns and pasted them apart on paper so I could extend the figures. I had a card index but I thought it too much trouble and threw it away. Now the whole pages, from any source, renumbered, without any cutting and as many as needed to complete the article are put between the covers and the indexing is merely to put a figure after the proper name in the AMERICAN MACHINIST index where one is almost sure to find the correct place, and cross index too to your hearts content.

H. F. CRAMER.

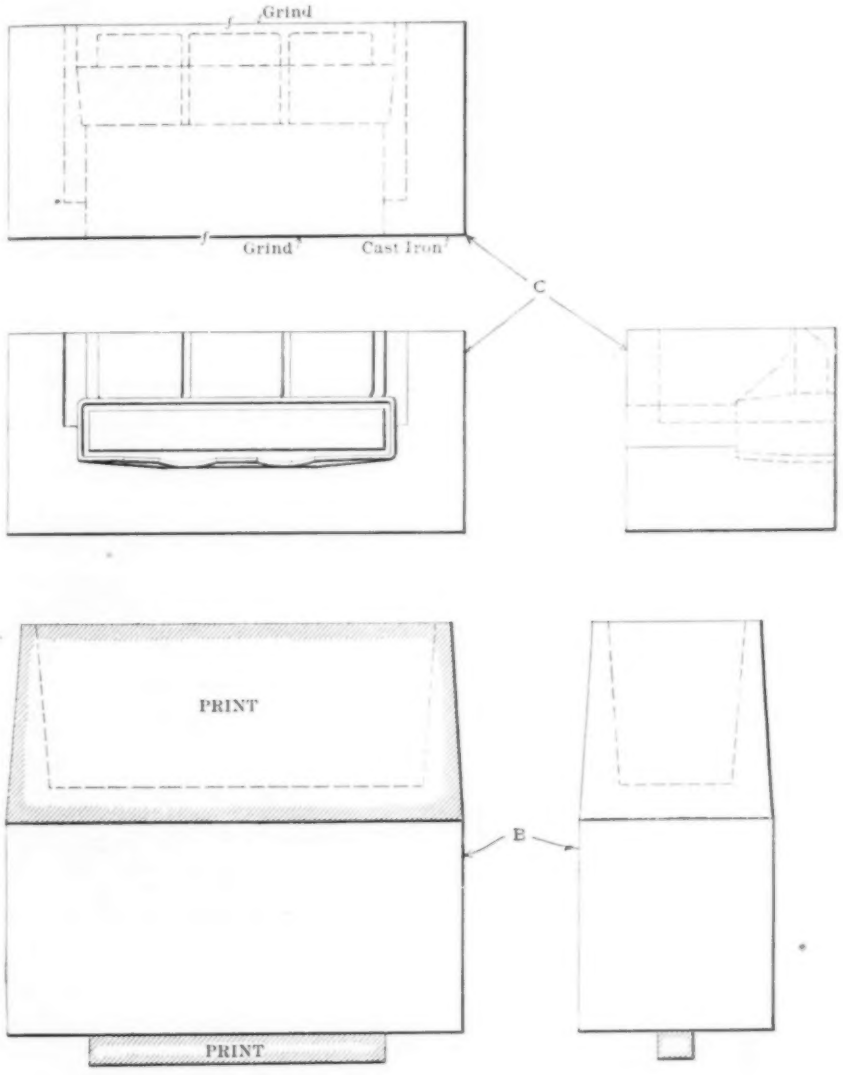


FIG. 3. THE BROACHING FIXTURE AND ITS PATTERN

The Jarno Taper and Others

While heartily agreeing with the writer of the editorial at page 896 as to the simplicity and handiness of the Jarno taper, I should like to offer some points regarding one existing standard, viz., the Morse taper. We recognized some time ago in our shop the necessity for standard lathe tapers, which arose principally from two sources, the desire to use taper shank drills in both headstocks and tailstocks, and the rapid replacing of old and worn centers. Having recognized that necessity we lost no time in furnishing for each lathe a required number of adaptors, or sockets, each of which was made externally to fit the original taper hole in the spindle of the lathe and internally the most convenient Morse taper. Having fixed our lathes up in this fashion we required centers with Morse tapers. The way we produced these has proved to be one of the most profitable points of the scheme. We, in common with all shops, have a number of broken or useless Morse Taper twist drills, T-slot cutters, etc. What more simple than to dress the broken ends of such to proper length with a few exceptions which must be longer and shorter (for reasons explained later), and grind them into centers? This is done on the universal grinder in sockets adapted to fit the taper-bore of the center spindle. Generally when ground they are found to be sufficiently hard.

In this way a number can be ground and sent to the stores to be handed out for use when required in exchange for those discarded. Not only is time saved but not half so many arbors get out of true through being worked on bad centers, for the machinist has every encouragement to change his center when at all out of shape. Often too, there are lathe jobs which require a longer or shorter center than the normal and the expense and loss of time entailed in making special centers for the job is needless under the system described.

Again, the advantage of this system is obvious when the chucking of work in the ordinary engine lathe is considered. Throughout the turning shops where this scheme is worked, circumstances demand that most of the lathes do each their quota of chuck work, and the greater efficiency obtained and time saved by the use of drills fed from the tailstock will be apparent at once.

For instance we have a piece of gray-iron, about 3½ inches diameter by 1¼ thick with a 3-inch recess in one face, which piece is to be machined all over and bored ½ inch standard. It is first set on the chuck with the jaws gripping the internal diameter of the recess and turned and finished on the face and side. Afterward it is reversed, set true in the chuck, an obviously simple matter, and turned to

dimensions in the recess and on the remaining side. It now only remains to bore the ½-inch hole. A 31/64-inch Morse twist drill is held in the tailstock spindle by the adapter and guided by a simple steady, held in the tool-post. The hole is then reamed by the same means, but without the aid of the steady. This may seem an unusual way of coping with the pieces in question, but the trouble of keeping arbors true and getting the work to drive under a fair cut, was ample reason for making what has proved to be a highly satisfactory change. E. W. H.

B——, England.

Repairing Micrometer Points

The micrometers referred to were of half-an-inch capacity, graduated to the metric scale, and were of a standard make. These were used continually for checking the sizes of work in several machine operations, in one particularly the pieces produced by lapping were sized and finished, and here extreme accuracy was essential. The job was running at a fairly high pressure and, as may be imagined, despite instructions and a liberal supply of benzoline, the finishing operator could not be induced to observe the cleanliness necessary to the reasonable preservation of the gage he had in use. Eventually sufficient inaccuracy was developed to result in a pile of rejected work from the examiners, which more effectually convinced him of short-sightedness than any form of argument or persuasion had done before. Another micrometer was substituted, and things were well again; there was a marked improvement in the time taken to bring the second down to the condition of the first, but in due course it became unreliable, and as no new one was again forthcoming there was no option but to repair.

How the Repair Was Gone About

At the outset I thought the undertaking somewhat formidable, but upon closer investigation the possibility of accomplishment assumed more ordinary proportions. The principle, as will be understood after perusal of the sketches, was that of surface lapping.

Preparation of a Block to Hold the Pieces

A, Fig. 1, was a piece of gray iron, which was chucked in a lathe and carefully faced to insure perfect flatness, this latter being most necessary, as any irregularity due to bad facing will be transferred to the gage point. Being satisfied with the condition of the face, with the block still in the chuck, a hole was drilled at *B*, leaving sufficient finish allowance for fitting to the diameter of the screwed and graduated micrometer point when removed from the body as at *C*, Fig. 2. To insure accuracy in being parallel, and at right angles to the turned face (two other important conditions), neither secondary drilling, reaming, or similar means was trusted, but this hole was opened to size by a small boring tool, as shown in Fig. 3. This was not the usual type, but, for reasons to be explained, was made double-edged, one edge in the usual position, the other inverted and opposite as are the edges of a twist drill. When used, the first cut through was taken in the ordinary way with the tool cutting the front side of the hole, then the tool was moved over until the opposite edge was in contact with the back of the hole and another light cut taken as it was being withdrawn.

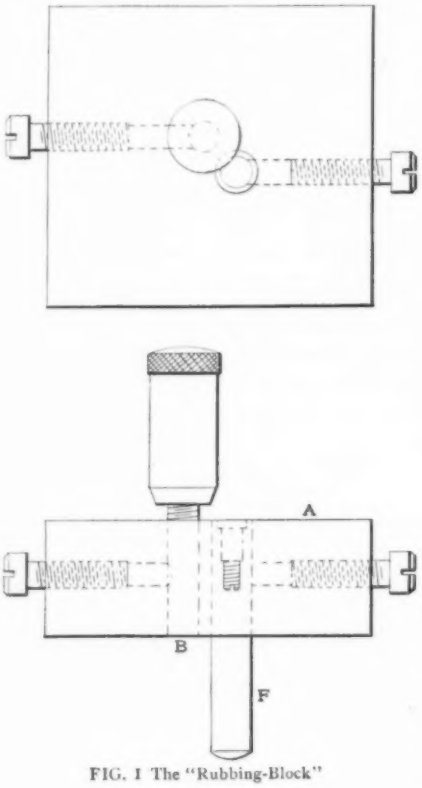


FIG. 1 The "Rubbing-Block"

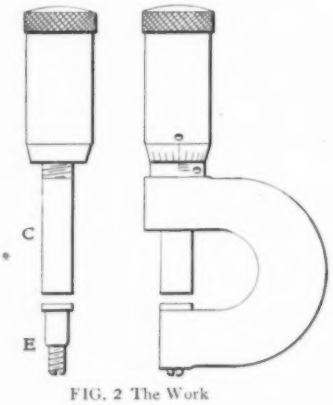


FIG. 2 The Work

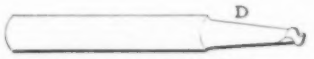


FIG. 3 Special Boring Tool

REPAIRING MICROMETER POINTS

Auditory Inspection of the Work

During this time a screw-driver was held from the tool to the ear to act as a sounder, and by this means any taper developed while cutting with one edge of the tool was exaggerated to the ear by the opposite edge, and was easily recognized and corrected until the cutting sound was uniform with both edges from end to end of the hole. This method (probably original in the application to boring) is identical with that used when doing external grinding.

The "Anvil" Held in an Auxiliary Piece

Having made a good fit of the first piece of the gage in the "rubbing block," attention was next turned to the fixed gage point, or anvil, as it is termed. This required even more care than the previous piece, owing to its want of length as seen at *E*, Fig. 2; it was therefore thought advisable and convenient to fit this first in a piece of steel stock *F*, and, in turn, to size this stock outside to another hole provided in the rubbing block.

Finishing the "Rubbing Block"

To go back to the details, having removed the iron block from the lathe chuck, it was changed about and held with the opposite face presented for treatment, exactly as before, except that this was drilled out and bored with the double-edged tool *D*, Fig. 3, sufficiently larger to take the piece of steel stock with the anvil inserted. This block was then removed from the chuck. The piece of stock *F* was chucked, and finished inside by drilling and boring a nice tight fit to the anvil point, and also turned outside to suit the hole in the block, this being done at the same setting, obviously to secure accuracy.

It remained now only to put screws glutted with brass in either side, and some mark to distinguish the different sides, and the "rubbing block" was complete.

The Use of Surface Lapping Plates

As surface lapping plates are by no means in common use in the shops here, it may be good to explain that they are of cast gray iron, having an area from 12x9 inches upward; well finished on either side on the planer, and used for the purpose of lapping the faces of hardened steel tools, etc. First (where necessary) a little flour emery is used, or if an extremely high finish is desired, nothing but the plain surface of the plate, generally the opposite side, is used. Upon one of these plates a gage point inserted in the rubbing block was worked until a surface resembling a mirror gradually spread over its whole area. This was repeated with the remaining point, after which the pieces were cleaned and returned to their places in the body of the

micrometer gage; they came together as when new, the operation being therefore a successful experiment.

England. B. NORTON.

Something New in the Measurement of Power

As a subscriber of the AMERICAN MACHINIST and faithful reader of that most interesting paper will you allow me to claim priority for Something New in the Measurement of Power? The dynamo coupled direct to the motor to be tested, and the field balanced so that it can be used exactly like the pulley of the Prony brake — regardless of the efficiency of the dynamo—has been in constant use in the works of the Panhard & Levassor Society ever since the year 1902, where a score of such brakes are daily engaged in testing every motor turned out by that firm.

That kind of brake, well known in France and in many other countries, was designed by myself and is fully described in the communication to the "Académie des Sciences" of which I send you a copy. A. KREBS.

Paris, France.

Rate Cutting Not Done Here

At page 104 you ask, "Is Rate Cutting Ingrained in the Managerial Mind?"

The writer cannot answer for managerial minds in general, but would like to state his own experience in this respect. The Halsey premium system has been in use for the past 10 years in two departments of the works of which I am superintendent. During this period there has never been a general cut in the time limits set at the start. On two occasions where improved methods have been introduced, the limit was lowered on certain kinds of work, but this did not lessen the premiums the men were able to earn. The highest premium ever earned in one day amounted to 70 per cent. of the hourly pay for the day. The average premium is approximately 18 per cent. of day pay.

The limits were set only after complete records of day work had been kept and tabulated for nearly a year. In all cases the limit was set below the average time taken under day work. The premium rate per hour is 35 per cent. of the day rate.

In several departments the work is of a character which renders the application of a premium system impracticable. The only serious difficulty we have had with the system has been the feeling on the part of men in these other departments that they were not getting enough as compared with what some of the men under the premium system were earning.

During all this time there has never been any pressure from "managerial" or "directoral" minds for a cut.

H. A. RICHMOND.

An Unusual Chip

The accompanying half-tone shows a part of a peculiar turning. It was about six feet long and was cut from a piece of

AN UNUSUAL CHIP

boiler plate at the rate of 60 feet per minute and a feed of 1/16 inch. Its peculiar form seems to have resulted from the tendency of the tool, so pronounced in all high-speed steels to "gather;" that is to say, as the tool is cutting, small particles of the chips adhere to the actual cutting edge, and make a false edge. Sometimes this false edge makes a deeper cut and sometimes, as in this case, it makes no apparent difference in the size of the cut but contents itself with producing a decorated chip. A. M. TURNER.

L——, England.

Mill Construction

In reference to the paragraph on page 10, Vol. 30, Part 2, stating that some firm is to put in a 7¼-inch thick solid wood floor, it may be of interest to you to know that a similar floor has been put in the new building of the Valley Ring Spinning Mill Company, of this town. Mr. Sidney Stott, the mill architect, of Oldham, in a lecture given to the Rochdale Association of Engineers during the building of this mill, stated that this type of construction was in his opinion quite as fire-proof as the steel and concrete arch construction often used in spinning mills, and gave an example where some oil-soaked cotton had blazed furiously under one of these floors for a considerable time, the only effect being to char the 6-inch planking to a depth of about ¼ to ⅜ inch.

J. BUTTERWORTH.

Rochdale, England.

Lifting the Planer Tool

By the looks of this device on page 101 the designer of it seems to have been easily satisfied, and quit before he completed the job. The cord appears to be fastened directly to the bracket on the farther end of the cross rail. Why couldn't Stanley have put a small pulley on this bracket, led the cord under this pulley, and then straight up to a ring bolt in the ceiling? Then the cord would not have to be altered in length every time the hight of the cross rail was changed.

WALTER GRIBBEN.

Another substance whose electrical conductivity varies with the intensity of illumination to which it is subjected, like selenium, has been discovered. F. M. Jaeger recently reported to the Dutch Academy of Sciences, says the *Scientific American*, that after noting the change in resistance of Japanese antimonite by a galvanometer when a ray of light fell upon it he investigated further to make sure whether this was actually due to the light or its accompanying heat. Heat alone applied to the substance was found to diminish its conductivity so that the changes noted in the opposite direction were clearly shown to be due to light alone. Strangely enough there were well defined maxima of sensitiveness corresponding to the red and blue waves, while between these colors as well as in the whole range of the spectrum the effect decreased. It is intended to conduct further experiments with antimonite, making it up into photo-sensitive cells similar to those in which an allotropic modification of selenium finds application. This class of substance may prove of practical value in solving the problem of sending pictures by telegraph.

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Contents

	PAGE
Work of the Floor-plate Boring Mill	215
Pointers for Checking Drawings	217
A Diagram for Calculating Moments of Inertia	218
The Spark Method for Grading Steels	219
Reboring a Press Pitman	220
A Large Hydraulic Flanging Press	221
Credit Where It Is Due	224
Making a Dial Measuring Machine	226
Making a Six-throw Crank-shaft Out of a Solid Bar	229
The Patternmaking of a Locomotive Cylinder	230
Tools for Manufacturing a Locomotive Bell Yoke	232
Practical Letters from Our Readers: Sectional Sub-press Punch and Die....Grooving Inserted-tooth Cutter Blanks on the Slotting Machine....Standard Proportions of Machine Screws....Nature of Contact Between Emery Wheel and Cutter Teeth....Milling Gas-engine Fly-wheels....A Use for Tracing Cloth....Cutting Gear Blanks on the Milling Machine....Several Pump Experiences....A Broaching Fixture....Indexing System....The Jarno Taper and Others....Repairing Micrometer Points....Something New in the Measurement of Power....Rate Cutting Not Done Here....An Unusual Chip....Mill Construction....Lifting the Planer Tool	234-241
New Discoveries of Anthracite Coal	242
A New England Planer	242
Coöperation as an Element in Factory Organization	243
New Publications	243
New Tools and Machine Shop Appliances	244
Experiences of a Printing-press Inventor	245
Personal	247

New Discoveries of Anthracite Coal

There is probably no other department of economic geology which has been so thoroughly studied, and about which such definite conclusions have been formed as the extent of the anthracite coal measures of Pennsylvania, and the quantity of coal which they contain. The coal measures have been mapped with the greatest care, and the tonnage which they contained computed. As a result we have been told for many years that the supply of anthracite is relatively limited, and that not many generations will elapse before it is exhausted.

But now comes W. E. Joyce, in The Engineering and Mining Journal, with the announcement of discoveries by J. H. Bohlin, which upset these estimates completely, and give very tangible reasons for believing that the supply of anthracite is far beyond the conclusions of the wisest. Mr. Bohlin, who is described as "the most profound geological student and most extensive prospector living in the mining region," has proved beyond the shadow of doubt that coal exists where reports of the Geological Survey say it did not. He has in the past proved that coal was available where the written authorities said it was not, but until recently his position was not regarded seriously. The latest evidence which he brings forth, however, is too strong to admit of contradiction or to be met by derision. In the Honey Brook district of the Lehigh & Wilkes-Barre Coal Company he has found coal where it ought not to have been, sufficient to add 100 years to the life of the mine—this new seam yielding, already, a heavy tonnage. Among those who had faith in Mr. Bohlin's theory was the former sheriff of Luzerne county, who as a result has now before him another find of Mr. Bohlin's which results in a property too great for his individual capital to develop properly.

The different basins in the Lehigh coalfield are considered more nearly exhausted than either of the other coalfields, but nevertheless Mr. Bohlin declares that this field contains more unmined coal than has yet been taken out of the ground; in fact, that the original coal measure has not been touched. That Mr. Bohlin has discovered large coal seams where, according to all accepted theories they ought not to be, appears to be proved, although how important and extensive the discoveries may prove to be is as yet uncertain. It seems altogether possible, however, that the smokeless atmosphere of our Eastern cities, which constitutes a blessing of the existence of which many of its inhabitants are scarcely aware, may be prolonged indefinitely instead of being comparatively short lived and followed in the not distant future by the clouds of smoke which overhang our Western cities.

A New English Planer

The first application of the electric motor to a planing machine developed a difficulty with which designers are still contending. That there was a good deal of energy required to reverse the machine had, of course, been known for a good while, and was, indeed, made manifest by the tendency of the belts to slip on the pulleys. The magnitude of the effort was not, however, suspected until motor driving was attempted, when it was found at once that the kick of the ampere meter needle went far beyond all anticipation, and introduced serious difficulties. Our readers are familiar with the introduction of fly-wheels in order to supply the required energy, but they were not found adequate for the purpose and ultimately the compounding of the motor became necessary, such motors being now used, as a regular thing. With both these expedients combined, however, there is still a heavy kick of the ammeter needle at the reversals, the result being that motors must be supplied for this purpose, having a capacity largely in excess of that necessary to do the actual work of cutting.

A recent number of *The Engineer* contains a very interesting account of a planer built by Joshua Buckton & Company, of Leeds, England, in which the energy of the moving parts is absorbed by a powerful pair of springs located at the ends of the bed under the table—the energy so absorbed being used to start the parts in the reverse direction. The machine is modern in every respect, being provided with variable cutting speeds and a return speed of 180 feet per minute, but between the various speeds no adjustments of the springs are required. The article includes several diagrams of ammeter readings which demonstrate clearly the action of the apparatus and show a very small and negligible rise in the current at the point of reversal and an actual drop in some cases. An illustration of a piece of work is also given in order to show the accuracy of the reversal, the result in this respect being remarkable. The machine appears to be a decided success and it is worthy of careful study by all planer makers.

In this connection it should be remarked that printing-press makers have been confronted with this problem for many years, and have long used a spring of some kind to assist the reversal of the platen. Our own presses are fitted with air-cushion cylinders instead of steel springs, the air springs possessing certain advantages which would seem to us to apply to a planing machine as well as to a printing press. One, and perhaps the chief of these, is the ease with which the air spring may be thrown out of action in order to permit the press to be turned over by hand. To accomplish this it is only necessary to open an air valve, which, by permitting the air to escape, suspends

the spring action entirely. In our own presses this air valve is controlled automatically by a governor. When the press is running at full speed the balls rise and close the valve, whereas, when the press is running at reduced speed, either by power or by hand, the governor balls drop and open the valve. Without attention on the part of the pressman the air spring is thus thrown into or out of action exactly as required, and the press may be turned over by hand just as readily as though the springs were not there. While there is less need of this in a planer than in a printing press the need is nevertheless still there, although in a planer a hand-controlled valve would probably supply every requirement. Our impression is also that the adjustment of an air cushion to suit varying lengths of stroke of the table could be made somewhat more readily than could a metallic spring.

One feature of the Buckton planer should be mentioned. While it is not described in detail it is apparent from the illustrations that it is not operated by shifting belts—the belts and pulleys running on continuously and the reversal of the table being, apparently, by a clutch action. Of course, it is well known that in shifting belt planers the larger portion of the effort required at reversal is called for by the pulleys and not by the table and the attempt to apply the spring apparatus to such planers might introduce serious difficulties by the violent reversals of strains in the gearing between the pulleys and the table. In a clutch planer the springs have only to reverse the table, this action being absent, and it is clearly not to be assumed that because the apparatus is successful in a clutch planer it is certain to be successful in a shifting belt machine.

Our belief is that if planer builders will inquire into the additional cost of motors necessary to supply the energy required for reversal in planers as they are now built, they will find, especially in planers with a high-speed return, a saving which will largely, if not entirely, offset the cost of the spring attachments.

Co-operation as an Element in Factory Organization

That there are real advantages from any kind of commendable coöperation no one will deny, and that there are such advantages from an active coöperation among the personnel of a factory organization needs no demonstration. However, not all works managers appreciate that this element may mean a great deal in increased factory output and profit, and more particularly perhaps in the time required for production of emergency work. A state of internal harmony and a spirit of mutual helpfulness are two factors worth striving for in any factory organization. They should be present in all ranks of the industrial life from the manager to the workman in the humblest position. As active forces they tend to an increased efficiency for the whole system.

In one factory with which we are acquainted a condition, the reverse of the one which we have outlined as advantageous, prevails. Here heads of departments are working for their own selfish ends and possible advancements, not for the best ends of the company in a broad sense. If a lot of work comes along which should have been done a little differently by the department performing the last operation, the department receiving it will curtly send it back, although correction might be made more easily and cheaply in the succeeding operation than by the methods of the preceding ones. Should work be in a rush, each department is intent only on completing its own part, not on helping the job by aiding departments having either preceding or succeeding operations. Machine work is done on material which should not have been started until other details were finished. Yet the department had the material and went ahead without caring for the best methods of production or the final result.

In the matter of transferring employees many foremen would rather discharge a workman than transfer him to a department where he would be of service. Requests for information between departments would be studiously overlooked or delayed, and if answered the data would often be incomplete or useless. Some individuals would misrepresent their neighbors to the management, and as is often true in such cases, the cleaner cut men suffered the more.

The factory atmosphere was one of discord and discontent, with a consequent loss of efficiency.

Another plant which we recently visited presented the other side of our proposition. From the general superintendent down, there was exhibited a spirit of mutual helpfulness. Each department tried to help the others. If any details of work were wrong, the department best adapted for correcting them would do so gladly, whether they were responsible in any way for the errors or not. Each department kept track of rush work in process and would often keep a machine idle for several hours waiting for work coming from another department. The desire was ever present to help the factory production in a broad way. Information was always gladly given whenever asked for. One department would "tip off" another in regard to coming work or any other matter of interest or importance. Men were gladly changed from department to department if it would contribute to the good of the factory organization. At all points was a spirit of active coöperation.

This harmonious condition seems to have been largely brought about by the efforts of one quiet, earnest man, a foundry foreman, who had the full confidence of his employers and who talked and acted coöperation. His influence, backed by the approval and aid of the management, had started the movement which had done away with petty jealousies and discords, and the plant was one great unit working for a common end—the best results for the company. It is needless to attempt to detail the advantages of this factor of factory organization. A little consideration will show to each one of us many points of real value in coöperation among employees. It is a contributor to success. Many schemes have been tried to aid in fostering this condition, suggestions, profit sharing, bonuses and others. Yet this harmony can be produced without these means. It is based on the broad principle of treating each man in a straightforward manly way.

Let us hope that internal coöperation will receive still more attention in our great industrial life and thus add another strong and helpful element.

New Publications

A Method for Calculating Steam Power Plant Economy. By C. R. Weymouth. 28, 9½x12½-in. pages, with numerous diagrams and tables. Chas. T. Moore & Co., San Francisco, Cal.

This publication is an altogether praiseworthy setting forth of the methods of attacking the problems which confront an engineer when deciding the many points which confront him in connection with the design of a power plant. We know of no publication from which so much information of immediate usefulness can be obtained in such small compass, and in fact much of the information would be difficult to find elsewhere. The publication includes a comparison of economies with steam and electrically driven auxiliaries, initial cost of plants, and total cost of power, the only limitation upon its usefulness being that it is adapted to Pacific Coast conditions and has especial reference to the use of oil fuel. While, of course, these limitations necessarily cut out the use of many of the tables and diagrams by eastern engineers, the fact remains that as a statement of the methods followed, the publication is of large value to anyone who has problems of this character to deal with. It is sent free to all applicants.

Iron castings pickled in hydrofluoric acid will not spot out as badly as when oil of vitriol is used. Neither are they so apt to peel when plated. The occlusion of hydrogen gas is apparently the reason for this difficulty when oil of vitriol is used for pickling.—*The Brass World.*

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

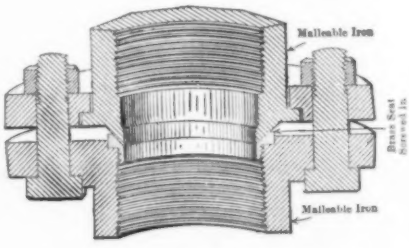
THE LATEST INFORMATION

An Embossing Press

The illustration shows a press built for heavy embossing on leather and paper. This press is capable of exerting 250 tons pressure. It has a steel frame, the section of the uprights being 10 by 5½ inches. The shaft of the eccentric type is made of hammered steel and has a stroke of 1 inch. The gear is a steel casting and both gear and pinion are machine cut. All the shaft bearings are bronze bushed. The press is fitted with an automatic die slide operated by crank *A*, Fig. 2, on the end of the shaft, through the toggle motion of the levers *B*, *C* and *D*. Fig. 2 shows the press with the back shaft, fly-wheel and pulleys removed. The table, having a travel of 11 inches, is quickly moved under the punch, stopping without shock, and registers against a gage in the back, insuring positive alinement between the die and punch. The bed has a wedge adjustment of ¼ inch. The dimensions of the machine are as follows: Diameter of shaft bearings, 6 inches; diameter of eccentric shaft, 7 inches; fly-wheel, 45 inches diameter, with 5 inches face; weighs 900 pounds and makes 310 revolutions per minute; the proportion of the gearing is 7⅔ to 1; the driving pulleys are 28 inches in diameter, 6 inches face, and the floor space over all is 65x75 inches. The machine weighs 10,000 pounds. This press may also be used for embossing and heavy forming of metal ware, in which case the automatic-slide feature is generally omitted. It is built by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

The "Kewanee" Flange Union

The flange union shown in the cut is designed to be made tight without the use of a gasket, and to remain tight even when the alinement of the piping is imperfect, the brass seat which is fixed in one malleable iron casting by screwing receiving in its concave part the convex part of the other malleable piece, thus



THE "KEWANEE FLANGE UNION"

forming what is virtually a ball joint. The "Kewanee" flange union is furnished in sizes from 1-in. to 10-in. pipe, either black or galvanized, by the Western Tube Company, Kewanee, Illinois.

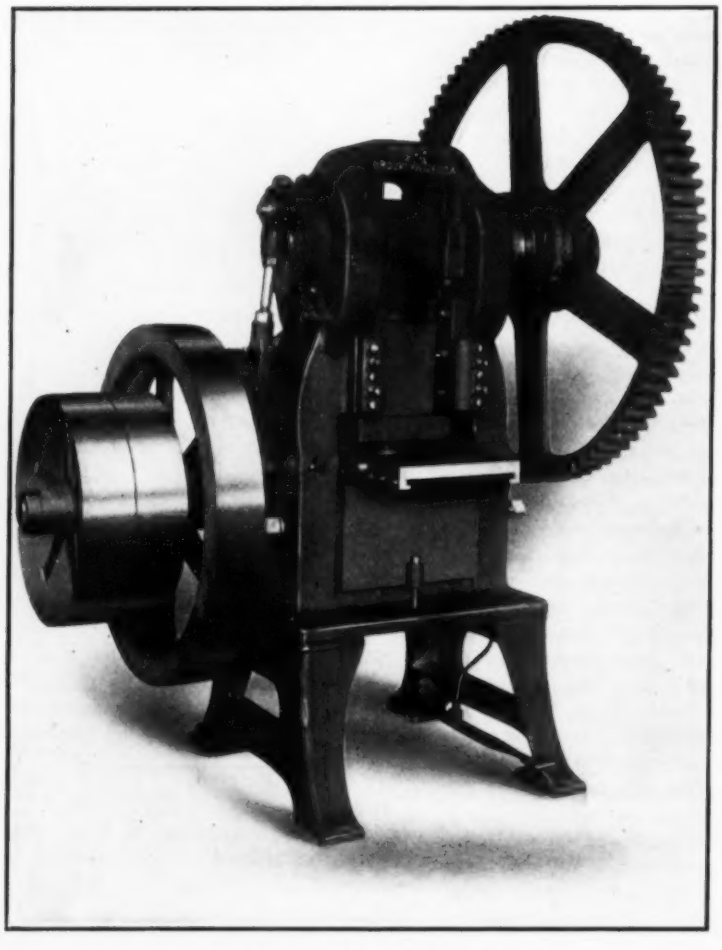


FIG. 1. FRONT VIEW OF EMBOSSING PRESS

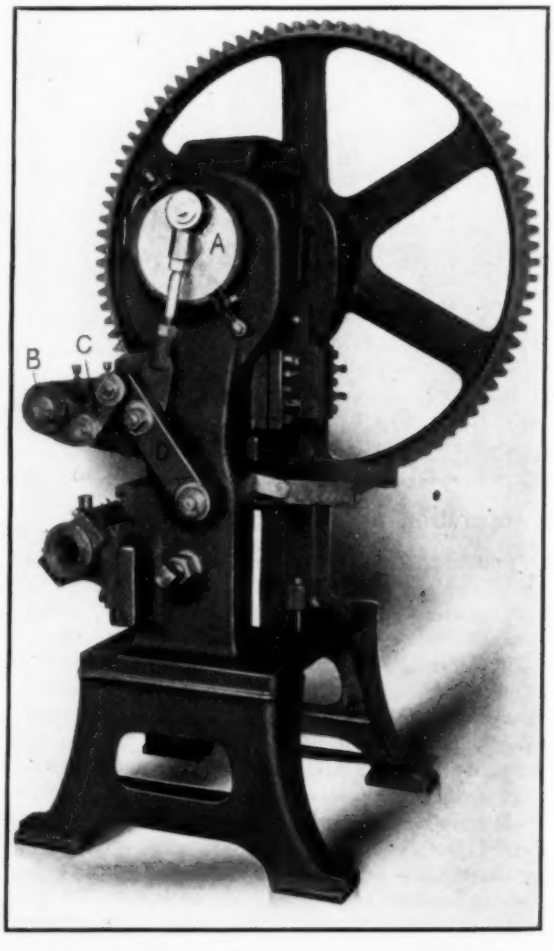
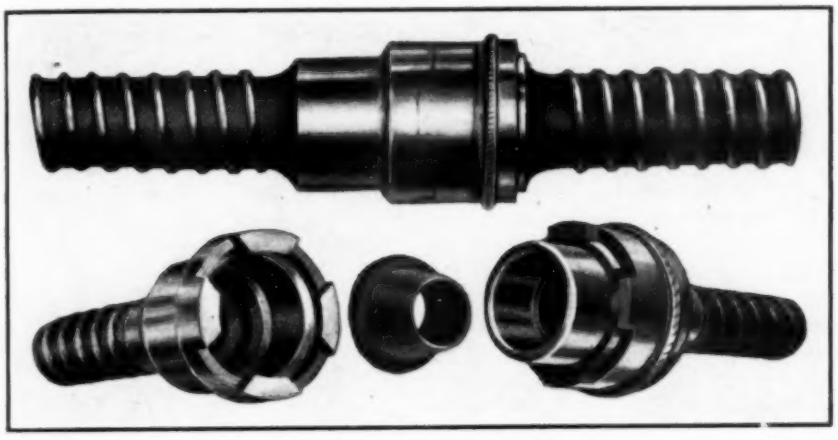


FIG. 2. SIDE VIEW SHOWING TABLE ACTUATING MECHANISM

A Coupling for Air Hose

The illustrations show a hose coupling assembled and disassembled. The gasket, shown in the center between the male and female ends, is of rubber composition and will withstand the action of oil or gasolene. It is held in the female half of the coupling by the flange, which fits into a recess. It cannot fall out, but is easily replaced.

When the coupling is connected, the tapered end of the gasket enters a conical opening in the male end, for which it is a loose fit. When the pressure comes on the coupling, this tapered end expands against the walls, making a perfectly tight joint. When the pressure is released the gasket does not adhere to the metal and is consequently not injured by being torn or squeezed. This coupling is made in six sizes, from ⅜ to ¾ inch diameter, by Thos. H. Dallett Company, Twenty-third and York streets, Philadelphia, Penn.



A HOSE COUPLING

It is stated that out of a total mileage on the Pennsylvania Railroad's eastern lines of 6032 miles of track, more than 1500 additional miles have within the last three years been equipped with block signals, at a cost of $856,520 to the railroad company, and adding $210,816 to the annual operating expenses. The signal report shows that the company now has every mile of its main lines protected by block signals, and of the entire mileage of the lines east but about 500 miles are not equipped with block signals. Most of the latter, however, are short, industrial lines or branch lines on which traffic is so light and of such a character as to render the block signal unnecessary.—*Electrical World.*

According to the *San Francisco Magazine*, on the average a new building has been finished every forty-five minutes in San Francisco since the fire. In ten years all the old business area will be covered and solid blocks of new business streets will be erected.

Experiences of a Printing-press Inventor

By William M. Clark

About one year before the Philadelphia Centennial, in 1876, I was casting bouquets at myself as the inventor of a new printing press, for which a fairly good construction patent had been granted.

I had been in the book and periodical publishing line for several years, and believed I saw the way clear to advertise the new machine very thoroughly and cheaply and establish a lucrative trade. I had made a crude model of the new press, and certain friendly old printers declared that I had all the other job presses "skinned to death." An interested machinist figured out that it could be built for a mere song.

While I was moderately well versed in the details of the publishing business, I was utterly ignorant of practical mechanics and iron working, a knowledge very essential in building so substantial and accurate a machine as a printing press. My experience, however, may serve to show the rugged path the cock-sure inventor traveled thirty odd years ago, when shops fitted with facilities for developing new machines were less numerous than they are today.

The Patternmakers' Bill

I started in with the patternmaker. After a series of vexatious delays the patterns of the new press were delivered to me. With them came a long explanatory bill of items, in which almost every conceivable source of expense was recorded—drawings, time, materials, shop-charges, wood-carving, hardware, etc., and at the end an additional item, "O. I. O. F." This last item was about 10 per cent. of the whole bill. Then I learned that "O. I. O. F." signified "other items omitted or forgotten."

Then to the iron foundry. The iron trade seemed to be on a higher plane, and there was more dignity attached to those engaged in it. I had to pass through considerable red-tape and several doors before I reached the dignitary to consult about iron castings.

At length one full set of castings was received and sent to the machine shop. It was now up to Hawles, the machinist, to assemble these castings into a printing press. I waited for a week, when I was sent for to come to the shop.

"Who made those castings, Mr. Clay?"

"Jenkinson."

"Thunder! Why didn't you go to the Empire? Everybody knows old Jenkinson can't make anything but stove plates and water-pipe. His iron is harder than Hades. Can't touch it with a tool, and 'twould take a week to drill one hole in that bed-frame."

Here was a mess. Red-hot I went to Jenkinson's, pushed through his red-tape line, and found the old man in his office.

"Mr. Hawles tells me that those castings you made for me are harder than flint, and he can't work them."

"Hawles doesn't know what he's talking about, and besides you didn't tell me you wanted extra soft iron."

Later I learned that a bitter enmity had long existed between Hawles and Jenkinson.

Correcting Mistakes

After a few weeks it was discovered that the patternmaker had not been careful in his reckonings. The parts would not go together properly, and new patterns had to be made and still more castings. But it is useless to narrate the interminable discouragements, in the building of that first press. It began to dawn upon me that I had started out wrong. A carefully designed and accurately calculated set of drawings should have been made by a competent draftsman, as a first step toward construction. From these proved lines we should have worked all the way through. I saw how much easier it is to alter a line on the drawing board than to chop out a block of iron into shape. I was learning fast, but in a dear school. The cost had already run away with twice the sum I had set aside to build my first press. But I had gone too far to turn back. The press was approaching completion and after a few weeks was pronounced finished. It had many mechanical defects, but did all and more than I had claimed for it, and was declared a success.

I had secured an exhibition space on the floor of Machinery Hall, at the Centennial. Here the press was installed and started up under the care of a competent printer, where "Centennial Souvenirs," and other leaflets were printed and distributed to the tens of thousands of rubbering visitors who passed along day after day from May until November.

While a number of mechanical faults had been corrected, there still remained one unsatisfactory feature that I felt, sooner or later, would cause trouble. In

an erratic cam movement, the cam-roller was inclined to clog and wear flat. Otherwise, the press seemed to be all right and likely to become a winner. It was much inquired after, and I had already booked some sales.

The Lawyer and the Royalty

One day a slick, well-dressed stranger called at my place of business, and handed me a card upon which was printed "Elbert Wilkinson Batt, Attorney at Law." He informed me that he was the legal representative of the World Manufacturing Works. This concern I knew of. The factory was in the interior of an adjoining State, and its principal business was the manufacture of a printing press bearing some reputation. Mr. Batt asked for my name, and what relation I bore to the business.

"You make a printing press?" he continued with a rising inflection of voice.

"That interests me, particularly as it is a direct infringement on my client's patents."

"In what is it an infringement, please?"

"In the cam movement operating the platen. These are the patent specifications, which will show quite clearly where you have pirated our mechanism." Then he pointed out certain specifications and referred to the drawings of this portion of his press.

"In what else have I infringed?"

"Only this one feature, sir, covered as you will observe by several distinct claims. But this is sufficient to institute suit for damages and to prohibit your further manufacture. Still, my clients are not disposed to treat you harshly, as doubtless you may have stumbled upon their mechanism inadvertently."

"I certainly was not aware that in using a movement common to so many machines that I was infringing anybody."

"We may be able to arrange the matter amicably, sir. How many presses have you actually sold?"

"Only five or six. I have just started this branch of the business."

"In that case we would permit you to use our movement and accept a royalty on each press you make and sell in the future and not consider the small number now in use."

"What royalty would you expect for such permission?"

"How would ten dollars a press strike you?"

"That will be quite satisfactory. Please put this agreement in writing, and I will sign it and you will sign for your people. This he did in duplicate, excluding six presses.

Cutting Out the Gooseneck

As soon as Mr. Batt had gone, I grabbed my hat and made a bee-line for the shop.

"Hold up on those presses a few days, Jack," I called to the foreman. "A lawyer has just called on me, and threatened suit for using that blessed cam."

"Do you mean that d——d gooseneck?" Jack Davis always called that cam a "gooseneck" when he hadn't a worse name for it. "Well, you ought to get down on your marrowbones and thank the Lord for that lawyer's visit. Now you've got to cut it out."

I had a little back room den at home. It was always in a delicious litter. I wouldn't allow it swept but once or twice a year, and then I did it myself simply to appease my wife. Into this den I went after supper that evening, determined to find a movement to eliminate that hateful cam. It was a long, hard night's task, but I had it worked out by 4 o'clock next morning. Then I went to bed and slept until 8. Before the 6 o'clock whistle sounded that evening Jack had the new movement on the press and running. Instead of a cam, there was a simple, easy-swinging pitman, which gave a compound toggle action to the platen, very powerful, and just what I had been dreaming of for months. There were no more "gooseneck" presses made. I sent out to my five customers, some time afterward, an offer to ship them improved presses for those they had. Only three came back, the others being reported satisfactory.

No Profit in Sight

I had yet completed only six presses, including the one at Machinery Hall. But their cost left me no profit even at list price. I had to meet sharp competition, and it became a question, under existing conditions, whether I should hold on or let go. To solve this problem I called on Mr. Hawles. I showed him some figures I had made which were far from encouraging.

"Isn't there some way out of this, Mr. Hawles? I believe I have a good press, that it will sell readily, and that it ought to be built 25 per cent. cheaper than any similar machine on the market. How can I do it?"

"Can you afford to put up any more money?"

"Yes; I could stand a little more. How much?"

"Enough to redesign the press, make new patterns, and complete special tools, jigs and fixtures to produce every part in duplicate. I have been studying out manufacturing problems all my life. I think we can reduce the number of parts very materially, and cut the actual manufacturing cost, at least 50 per cent. But it will require some cold cash to do it."

"But how much?"

"About twenty-five hundred dollars. If I do the machine work I will charge you only regular shop rates. I will recommend you to a reliable draftsman and the patternmaker who has done my work for years. I think we can save a few hundred for you out of the twenty-five. You have the nucleus of a money-maker. I am so impressed with it, although my hands are full, I'll agree to furnish the twenty-five hundred dollars for a substantial interest in the business, and relieve you hereafter of worry over the manufacturing end."

"I must consider this matter for a few days, Mr. Hawles. I don't think I began this thing right."

"I wish to say to you, Mr. Clay, that perhaps I should have suggested this course at first. I believe, however, if I had the press would have never been built."

"Most probably I would have deferred it, to say the least. But I have loosened up considerably more than twenty-five hundred dollars as it is, and it is not clear to me how I can make another move."

"You can move in the way I suggest and win. In nine cases out of ten, yes, more than that, ninety-nine out of a hundred, the one machine made for a patentee is the last. You are the lucky hundredth man, and every dollar you have spent in demonstrating that fact has been well spent. Consider this phase of the question before you decide."

I gave the subject careful thought for a week; then was compelled to decide for myself. I would go ahead and hold on to the whole thing. The course outlined by Hawles only confirmed the conclusions I had arrived at long before.

It required nearly four months to produce the first press of the new design from the jigs and other special tools made for the purpose. The actual cost was very close to twenty-five hundred dollars. But the net cost of future presses had been cut down to less than one-half of what each of the five machines I had sold stood me. I was now in condition to go ahead profitably and meet any reasonable demand promptly. Within a year I sold three or four hundred presses and the demand was increasing, having booked one order from a Cincinnati dealer for seventy-five machines. Afterward this dealer's orders aggregated several hundred presses.

Where the Lawyer Missed It

Some six or eight months after Mr. Batt's visit, he appeared again. He was dressed still more faultlessly than before, and was in a particularly pleasant mood. With a cordial shake from his gloved hand, he remarked:

"Business pretty good I hear."

"Fairly satisfactory sir, fairly."

"Well, Mr. Clay, my time is rather limited today, and with your permission we will go over your books and see how large a check you can give me on royalty account."

"I am afraid that I can pay you nothing today, Mr. Batt."

"How is that, sir?" he replied, beginning to show his teeth. "My clients insist that I hold you to the letter of the agreement."

"I am perfectly willing to abide by the agreement, sir."

"Then why not produce your books, so that we can make a settlement?"

"We can arrive at a settlement much easier and more quickly in another way. Please step into the wareroom with me." He accompanied me through a partition door to the rear of the store.

"Mr. Batt," I continued, "I never made another cam-movement press since the day you called, several months ago. Of the five or six presses I had then sold, three were replaced by this improved machine, and those returned destroyed. That cam movement was so very unsatisfactory that I had long ago determined to abandon it. Put your foot on the treadle and try this press, sir. Examine carefully that platen movement. Doesn't it make your cam look like a wayback number? At least, it looks that way to me."

A glance was sufficient. With a rather sickly smile he bade me a feeble adieu and went away. That was the end of the infringement case.

Personal

J. E. Lynch, who has been for awhile with The James Saunders Company, Dayton, Ohio, in the interest of the Carroll Increase Swing Lathe Attachment, has severed his connection with the Saunders Company.

E. B. Boye, until recently manager of the Cleveland office of Messrs. Manning, Maxwell & Moore, has accepted a position with The Warner & Swasey Company Cleveland, Ohio, as its Chicago representative.

J. Cecil Nuckols, for the past three years advertising manager of The S. Obermayer Company, Cincinnati, Chicago, Pittsburg, has recently received the additional appointment of advertising manager of The Cincinnati Electrical Tool Company.

Harvey E. Brown, managing director of the Maximus Brake Syndicate, Ltd., Queen Anne's Chambers, Westminster, London, England, is in the United States looking after the introduction here of the Maximus brake. Mr. Brown's present headquarters are at the Southern Hotel, St. Louis, Mo.

Prof. Charles Henry Benjamin has been appointed dean of the school of engineering of Purdue University. He will succeed Prof. W. F. M. Goss, who has resigned to accept a similar appointment in the University of Illinois. Professor Benjamin has held the chair of mechanical engineering in the Case School of Applied Science since 1889, previous to which time he was for three years engaged in the practice of engineering and for six years professor of mechanical engineering in the University of Maine, his *alma mater*.

Frank Richards, formerly associate editor of the AMERICAN MACHINIST and more recently connected with the publicity department of the Ingersoll-Rand Company has been appointed managing editor of *Compressed Air*. This paper, which is now 11 years old, will in future be published by The Compressed Air Magazine Company, 11 Broadway, New York City. Under the able management of Mr. Richards, it will, no doubt, be an even more useful publication than in the past, and that is saying a good deal.

F. B. Duncan, formerly general superintendent of the Northern Electrical Company, and since manager of the Akron Electrical Manufacturing Company, and H. C. Hale, until recently manager of the Mineral Ridge Manufacturing Company, previous to which time he acted as mechanical engineer and designer of mining machinery for Webster, Camp & Lane and Wellman, Seaver & Morgan Company, have organized at Cleveland the firm of Hale & Duncan, contracting and designing engineers. They will pay special attention to electrical equipment of mines, although Mr. Duncan will continue to devote considerable attention to motor-driven machine tools.

Business Items

The Pittsburgh Automatic Vise and Tool Company, general offices, Pittsburg, Penn., reports a very large volume of business from its exhibit at the Jamestown Exposition.

The Keystone Steel Casting Company, Chester, Penn., advises us that its crucible steel and McHaffie steel departments are now in full operation and that it has a large number of orders on its books.

Roth Bros. & Co., Chicago, Ill., manufacturers of motors, dynamos and electrically driven tools, have opened an office at 136 Liberty street, New York; Geo. F. Schminke, manager.

The Bullard Machine Tool Company, Bridgeport, Conn., at its recent directors' meeting elected E. P. Bullard, Jr., president; S. H. Bullard, vice-president, and A. H. Bullard, secretary and treasurer.

The factory of the Morse Twist Drill and Machine Company, New Bedford, Mass., will be closed for vacation during the week of August 26-31. The office and shipping department will, however, remain open.

The Atlantic Coast Line Railway Company has installed at South Rocky Mount plant, a 5-ton, 3-motor electric crane, span about 72 feet, the crane being furnished by the Northern Engineering Works, Detroit, Mich.

The factory of the American Emery Wheel Works, Providence, R. I., will be closed for vacation and repairs from August 3 to 10, inclusive. During this time the office will be open, but no shipments will be made until the resumption of work on August 12.

The E. H. Mumford Company, Philadelphia, has been made the sole selling agent for the Bonvillian-Ronceray universal system of machine molding, including the hydraulic power molding machines, the method of making stripping-plate patterns and the cliché process for paterns which are not stripped.

The Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio, is converting its steam power plant into a gas electro power plant by installing a Bogart gas engine, manufactured by Clark Brothers Company, Belmont, N. Y., direct connected to a direct-current generator built by Burke Electric Company.

The Turner Brass Works, formerly of Chicago, have completed their new factory at Sycamore, Ill., and are now occupying it. The main factory building has a floor space of 40,000 square feet, with power and heating plants additional. Improved machinery has been installed and their facilities enlarged and greatly improved.

The Lunkenheimer Company, of Cincinnati, Ohio, gave its forty-fifth annual picnic at Whitewater Park on July 27. The firm furnished all refreshments, cigars, transportation, music, etc., free of charge. A troupe of actors was hired for the afternoon and a vaudeville was given. Prizes were awarded to the winners of various contests.

On and after August 1, 1907, John H. Graham & Co., of 113 Chambers street, New York, will have exclusive control of the sales department of G. W. Griffin & Co., representing them for the sale of Griffin hack saw blades, etc., which for a number of years have been sold through C. E. Jennings & Co. John H. Graham & Co. will make all quotations, receive orders, bill the goods and make collections.

The Cincinnati Planer Company has increased its capital stock from $200,000 to $400,000. The additional capital will be used to cover the cost of the new plant now being built at Oakley, Ohio, which is a suburb of Cincinnati. This plant will be equipped complete with new machinery which will be operated exclusively on large planers from 6 to 12 feet square. The present plant will continue to be operated on the smaller sizes. The new Oakley plant is now well under way and will be completed some time in September.

Trade Catalogs

Norton Company, Worcester, Mass. Catalog of grinding wheels and machinery. Illustrated, 146 pages, 6x9 inches, paper.

Emmert Manufacturing Company, Waynesboro, Penn. Catalog describing universal vises. Illustrated, 16 pages, 3½x6½ inches, paper.

American Locomotive Company, New York. Catalog of eight wheel type passenger locomotives. Illustrated, 60 pages, 6x9 inches, paper.

The Newell Engineering Company, Ltd., Warrington, England. Catalog of gages and measuring machines. Illustrated, 68 pages, 6x9 inches, paper.

Boston Gear Works, Norfolk Downs, Mass. Catalog E, describing line of gears, also chains, sprockets, bearings, etc. Illustrated, 88 pages, 3½x6 inches, paper.

Buffalo Steam Pump Company, Buffalo, N. Y. Catalog 187, describing steam, power, centrifugal and turbine pumps. Illustrated, 132 pages, 6x9 inches, paper.

The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. Catalogs describing 20-inch high speed lathes, 24-inch high speed engine lathe and reducing lathe, turret lathes and equipments. Illustrated.

The Adjustable Collet Company, Cleveland, Ohio. Catalog entitled "Steps to Economical Shop Practice" which describes A. C. adjustable spring collets and A. C. automatic spring collet attachments. Illustrated, 12 pages, 6x9 inches, paper.

Manufacturers

The Belknap Iron Foundry, Laconia, N. H., will be enlarged.

The Milwaukee (Wis.) Novelty Dye Works, will erect a new plant.

The Keyes Fiber Company, Cohoes, N. Y., will erect a new factory.

The New Castle (Penn.) Portland Cement Company will erect a plant.

The Dayton (Ohio) Pipe Coupling Company is erecting a new factory.

The Federal Furnace Company will enlarge its plant at South Chicago, Ill.

J. J. Lacy & Co., Baltimore, Md., will erect an addition to their foundry.

W. H. Sawyer & Sons, Americus, Ga., will build a new foundry and pattern shop.

The Indianapolis (Ind.) Motor Car Company will erect a new three-story factory.

The Lake Shore Engine Works, Marquette, Mich., will erect a new and larger plant.

The Mexican Central Railroad will enlarge the shops and roundhouse at Guadalajara.

The Vote-Berger Telephone Company, La Crosse, Wis., proposes to erect a new factory.

The Marine Metal and Supply Company, of New York, will erect a plant in Jersey City, N. J.

The St. Petersburg (Fla.) Electric Light and Power Company will add a new machine shop.

The plant of the Northern Motor Car Company, at Port Huron, Mich., will be doubled.

The Crown Cork and Seal Company, of Baltimore, Md., will erect a plant in Toronto, Canada.

The Bossert Electric Construction Company, Utica, N. Y., has bought site for a new plant.

Plans have been drawn for an additional foundry to be erected by George H. McKinley, Moline, Ill.

A new machine shop for the Earle Gear and Machine Company, Philadelphia, Penn., will be erected.

The Washburn Car Coupler Company, Minneapolis, Minn., will build a new plant of large capacity.

The American Manufacturing Company, New Orleans, La., will make improvements to its woodworking plant.

The White Trunk and Bag Company, Nashville, Tenn., will rebuild its plant recently destroyed by fire.

The Newell Sanders Plow Company, Chattanooga, Tenn., has purchased more land in order to extend its plant.

The Crawford Automobile Company, Hagerstown, Md., will erect additional buildings in order to increase its output.

The American Window Glass Company, Hartford City, Ind., will double the capacity of its plant, expending $40,000.

The Winchester Repeating Arms Company, New Haven, Conn., is building an addition to be used for erecting machinery.

The Roper Lumber Company, Newbern, N. C., is erecting a building to be equipped as a machine shop and planing mill.

The Wm. B. Pollock Company, Youngstown, Ohio, is planning extensive improvements including a new machine shop.

The Tampa (Fla.) Electric Company will enlarge its plant and change some of its oil burning furnaces to coal burning furnaces.

E. M. Jordan, Norfolk, Va., will build a garage which is to be equipped with tools for automobile repair work, at a cost of $35,000.

The Falfurrias (Texas) machine shops has been incorporated by Ed. C. Lassier, L. D. Miller and M. A. Newman. Capital, $10,000.

McKinnie Veneer & Packing Company, Paducah, Ky., will rebuild its box factory, recently burned, at a cost of about $10,000.

The Barcalo Manufacturing Company, Buffalo, N. Y., making iron and brass bedsteads, will, it is said, build an addition to its plant.

The Levy & Heilprin Manufacturing Company, Philadelphia, Penn., making air guns, etc., will make extensive alterations to the plant.

A new tool and machine shop will be erected at the University of Kansas, Lawrence, Mass. This will be put up by the students.

The General Fire Extinguisher Company, Auburn, R. I., will erect a new two-story building to be used as a foundry and charging house.

It is announced that the Carnegie Steel Company will completely rehabilitate the Braddock, Penn., plant at a cost of about $2,000,000.

The Reynolds Refrigerator Company, Omaha, Neb., contemplates putting up an additional building which will quadruple its present capacity.

A new factory building to cost about $20,000, will be erected for George B. Grant, who is president of the Philadelphia (Penn.) Gear Works.

The E. and T. Fairbanks Company, St. Johnsbury, Vt., scale manufacturers, has decided to establish a branch factory in Sherbrooke, Quebec.

It is reported the Pennsylvania lines west contemplate the erection of a new shop and roundhouse plant at Lawrence junction, south of New Castle, Penn.

The Hanlon Nut-Lock Manufacturing Company, New Liberty, Ky., has been incorporated. Incorporators, D. B. Hanlon, T. H. North and W. S. Ball.

The Leader Foundry Company, Quincy, Mo., has been organized. Capital $15,000. Organizers, Chas. H. Achelpohl, J. H. Vanden Boom and Henry F. Dayton.

The Armstrong Machine Company, Louisville, Ky., has been incorporated with $10,000 capital by Harry Y. Armstrong, Thos. L. Jefferson and Floyd W. Jefferson.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper list free. E. G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

We desire a few more machines or specialties to manufacture. Box 423, Troy, N. Y.

Machines designed and built. Walter S. McKinney, M. E., Broadway, Flushing, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Mechanical engineer can act as New York representative for small salary. G. E. Hackett, M. E., 71 Nassau St., New York.

We will do your manufacturing for you; well established and equipped foundry and machine shop. Emmert Mfg. Co., Waynesboro, Penn.

Well established concern will pay royalty for several good patented machines or tools to manufacture. Emmert Mfg. Co., Waynesboro, Penn.

Wanted—Small space in well equipped machine shop where good castings can be procured, suitable for machine tools. Address Box 288, AMERICAN MACHINIST.

Mechanical engineer wanted by old engine manufacturing firm; high rating; thoroughly prosperous; must invest and be permanent. Box 291, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Men who operate grinding machines should read H. Darbyshire's "Precision Grinding," a $2 book that's worth ten times that money to you. Hill Pub. Co., 505 Pearl St., New York.

Design wanted for a practical, light portable motor, using steam or compressed air; can be of either the rotary or reciprocating type; give full particulars and send blue print. Box 230, AMERICAN MACHINIST.

An up to date modern foundry equipped to make large work, would like to get in touch with machinery builders who are in need of heavy gray iron castings; low freight rate to all eastern points. Address Box 242, AM. M.

A well equipped machine shop and foundry desires to add to its output by the manufacture of articles of brass and iron, which would find a ready sale in the south; correspondence invited. Box 122, AMER. MACH.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

The Forest City Specialty Mfg. Co., of Rockford, Illinois, would like to receive catalogs from machine tool manufacturers and dealers; also catalogs of machine shop equipment and supplies in order to complete their catalog file.

Remarkable invention by an old practical internal combustion engineer; patents just granted; a rotary, valveless, explosive gasolene engine; reversible by spark control; opportunity for capitalist. "Partner," Box 273, AMERICAN MACHINIST.

Wanted—Machinery to build and market; will buy or take under royalty for manufacturing and marketing new machines or appliances of merit in the iron line; give full particulars or no attention will be received. Address "Strictly business," Box 275, AM. M.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in classroom and by correspondence. The New York School of Automobile Engineers, 146 West 56th Street.

Planer hands—C. Ashley, a planer hand, has written a book "Planer Kinks," for practical planer men and every planer hand should get it; $1 postpaid. Hill Pub. Co., 505 Pearl St., New York.

Salesmen, a paying side-line for you. We will allow a liberal commission for selling a new automatic hose-coupling of exceptional merit which we are placing on the market. This is a rare opportunity to substantially increase your income. Thos. H. Dallett Co., 23d and York, Philadelphia.

An established, successful manufactory, gross business $70,000, net profits, $14,000; can sell double present output to present stockholders; needs $100,000 additional capital to extend plant; investment secured by bonds or stock; active position can be obtained if desired; audit and complete investigation allowed. Address "Factory," Box 272, AM. M.

We have a special proposition for a few bright, energetic mechanics, such as foremen, draftsmen or machinists in different sections of the country; no canvassing or selling of any kind, and, while not interfering with your regular work, pays well for the time taken; we want only practical men who can be depended on to give the little time required each week; further particulars on application. Box 102, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

A machinist wishes a position as superintendent or foreman; experienced on engine

work and all kinds of machinery; fully competent in all parts of the business. Address "Competent," Box 289, AMER. MACHINIST.

ILLINOIS

Experienced designer wishes to change; now chief engineer of prominent engine manufacturer; position as manager or superintendent with financial interest desired. Box 259, AMERICAN MACHINIST.

Assistant foreman in large manufacturing concern, experienced with machine, bench, and automatic screw machine work, desires executive position in Illinois, Iowa or Missouri, open for position October 1. Box 296, AMERICAN MACHINIST.

Superintendent with experience at handling men, reducing costs, and increasing output, both, in standard and engineering lines wishes to make a change; would prefer Chicago, or vicinity; now employed, but can change in thirty days. Box 271, AM. MACH.

MASSACHUSETTS

A first-class mechanical engineer who during 1889 to 1891 equipped the factory of the Mergenthaler Linotype Co. with special tools and methods enabling this concern to build 60 linotypes per month, and who during 1899 to 1905 developed ideas of Mergenthaler on logotype machines and invented many new things thereto, all of which were, or are being patented and were sold for a fortune, desires a position; now employed; desires to leave east on account of ill health in family. Box 269, AMERICAN MACHINIST.

NEW JERSEY

Mechanical engineer, with 5 years' experience in factory management, will be open for an engagement Sept. 1. Box 277, AM. M.

Young man, 25 years old, with five years' shop experience, three years as draftsman and one year as checker, desires position with future advancement. Address Box 276, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Address Box 297, AMERICAN MACHINIST.

Practical draftsman wants position near New York or Philadelphia. Box 295, AM. M.

Machine shop foreman with inventive and organizing ability wishes to change. Box 281, AMERICAN MACHINIST.

Mechanical engineer, technical graduate familiar with modern factory methods, desires change of position, prefers New York City. Box 280, AMERICAN MACHINIST.

Superintendent of machine works seeks position; has had extensive experience on medium and light work and can handle men to best advantage; highest references as to ability. Box 298, AMERICAN MACHINIST.

Position as superintendent or general foreman by a young man with executive, mechanical, and change ability; experienced in modern shop practice, stock, cost, tool systems, automobiles and drop forgings. Box 293, AMERICAN MACHINIST.

Mechanical engineer, graduate, 29 years old, holding position as foreman in auto. machinery, wishes position as assistant superintendent or erecting engineer; has also experience in structural steel and electrical lines. Box 274, AMERICAN MACHINIST.

Graduate M. E., shop experience, age 32, designer of high ability; 10 years' experience on fine machinery, typewriters, etc., tools, fixtures, special machinery, at present employed, will accept responsible position; location immaterial. Address Box 260, Auburn, N. Y.

Mechanical draftsman having three years' experience as shop foreman, six years as designer of special and automatic machinery, high-class tools, compound and sub-press dies, etc., competent to take charge of room, desires position. Box 285, AMER. MACHINIST.

Mechanic; intelligent and competent, with original ideas, to design, make, manufacture or take charge; 10 years' practical experience on tools, small and medium sized machinery, metal pattern, instrument and experimental work; best references. "Inventive." Box 287, AMERICAN MACHINIST.

I am a foreman pattern maker with fourteen years' experience in all classes of pattern work, five years' as foundry assistant superintendent; my determination to advance more rapidly than possible where now located has prompted this inquiry; I feel I can convince you of my executive ability, tact and energy; am thirty years old and greatly desire to connect myself with a good live company, who will give me the opportunity to apply my every effort to their interest and recognize merit when shown. Address Box 257, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Position as advertising manager with manufacturing concern, preferably in mechanical field, by a woman with years of experience in that capacity and field, with large, representative houses; thoroughly competent to handle printing, illustrating and the preparation of copy; at present employed; reasons for seeking change made known to prospective employer. Box 103, AMERICAN MACHINIST.

RHODE ISLAND

Experienced designer on automatic and general machinery, jigs and tools seeks permanent position. Box 284, AMER. MACH.

Designing draftsman wants position; experience in fixtures, jigs and automatic tool machinery. Box 283, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Toolmakers experienced on fixtures, dies and gages. Address with full particulars as to experience, wages required, giving definite time as to commencing work. Ross Rifle Company, Quebec, Canada.

CONNECTICUT

Wanted—First-class all-around machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Tool and die makers wanted; a number of first-class die makers on punching, bending and blanking dies for sheet-brass and steel work; also toolmakers, especially on cutting tools, such as millers, reamers, taps, etc.; steady employment for the right parties. Apply at once to The Yale & Towne Mfg. Company, Stamford, Conn.

ILLINOIS

Wanted—Permanent position open to an American with technical education and first class experience as designer on automatic metal-working machinery; no applications will be considered unless experience is given in full, with references, age and salary expected. Box 290, AMERICAN MACHINIST.

INDIANA

Wanted—Five good toolmakers and six lathe men; good wages; steady employment. The Western Motor Co., Logansport, Ind.

Wanted—A working foreman; must be a practical die and toolmaker, one who has had experience in the drawing of light sheet metal specialties such as bottle screw caps preferred; must have executive abilities; sober and able to furnish good reference; give age, state if married or single and salary expected; a permanent position for the right man. Address Bernardin Bottle Cap Co., Evansville, Ind.

MASSACHUSETTS

Wanted—Expert machinists; must be all around men able to do close high-grade work; $3.50 a day. Box 87, Springfield, Mass.

Wanted—All around union machinists and die makers; 50 hours work, 54 hours pay, for accurate flat work; experienced men wanted, others don't reply. Address stating age, experience, wages expected and earliest date for commencing work. Box 292, AMER. MACH.

NEW JERSEY

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

NEW YORK

Wanted—First-class toolmakers on tools, jigs, and fixtures. Boxes 7 and 8, Syracuse, N. Y.

Wanted—Experienced all around machinist, 30 miles from New York. Apply by letter to Frank Brookfield, 220 Broadway, New York.

Wanted—A first class automobile repair man; one with executive ability and push, to take charge of repair department with one of the largest automobile factories in the East; only competent men who are holding similar positions need apply. Address "Auto," Box 286, AMERICAN MACHINIST.

Wanted—General foreman for machine shop employing 75 to 100 men, building machine tools, special machinery, etc.; must be thorough mechanic, with tact, resource and push; capable and familiar with handling men and work to best advantage; good opportunity and future for competent man, with rapidly growing business. Address with full particulars as to experience, age, references, etc. Box 256, AMERICAN MACHINIST.

Master mechanic to take charge of repairs, maintenance and improvements of a manufacturing plant which also employs its own machine shop; must be inventive and capable of economically designing and constructing small as well as large labor saving devices and by experience well versed in modern shop practice; state fully and in detail experience and salary wanted; unexceptional references required. Box 294, AMERICAN MACHINIST.

Machinists for lathes, planers and floor work wanted; day and night shift; we are increasing our force and offer here an excellent opportunity for energetic mechanics who have determination to forge ahead; the future advancement of all our employees depends entirely upon their capabilities and energy; we recognize merit as fast as the opportunity offers; when applying state wages desired. Apply Ingersoll-Rand Co., Painted Post, N. Y.

OHIO

Wanted—Experienced punch and shear draftsman; state qualifications, age, and salary expected. Box 70, AMER. MACHINIST.

Wanted—Several draftsmen familiar with steam hammer designing; state age, experience, and salary expected. Box 71, AM. M.

Wanted—Foreman to take charge of shop in Ohio, employing fifty men; must have experience in the manufacture of wood-working machinery; state age, experience, reference and salary. Address Wood, Box 279, AM. M.

Wanted—Machinists and operatives; we are about to remove our machine shops from Kent, Ohio, to Franklin, Pa. Some of our present employees own their homes in Ohio and do not wish to leave them so are seeking other permanent employment here. We therefore offer to qualified persons positions in our present plant from now until about October first and permanent positions to those who then move with the plant to Franklin, Pa. To such persons who accept service with us under the present conditions, we will guarantee the best permanent positions when our Franklin plant is in operation, giving the preference even over present residents of Franklin. Franklin is a beautiful little city of 12,000 inhabitants with excellent schools and other facilities. We have no labor troubles in our shops nor have we ever had any. Address communications to C. L. Winey, Works Manager, Kent, Ohio.

PENNSYLVANIA

Wanted—Lathe, planer and boring mill hands. The Blaisdell Machinery Co., Bradford, Pa.

Wanted—Foreman for gear cutting department; must have experience; apply with particulars to R. D. Nuttall Co., Pittsburg, Pa.

We are just completing the fitting up of a modern machine manufacturing plant, and invite applications for employment from machinists, pattern makers and molders; steady employment and good wages for reliable and desirable workmen; when writing give full details of experience. The Shepherd Engineering Co., Williamsport, Pa.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery; good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

VIRGINIA

Wanted—Two or three first-class draftsmen, those familiar with steam shovel and dredge designs preferred; give full experience and salary expected. Box 882, Richmond, Va.

For Sale

A good 20 h.p. return tubular boiler. Pittenger Roof Paint Co., Elyria, O.

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, O.

For Sale—Ten volume library covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

One 10x10x12 duplex steam pump; one 10x14x12 Rand air compressor; one No. 3 Toledo punch press; two hydraulic presses, will take in material 35"x35". Shartle Brothers, Middletown, O.

A rare opportunity; a fully equipped machine shop for general repair and manufacturing purposes (in greater New York) with established business; no canvassing necessary; fine location, low rental, will sell at a sacrifice to quick buyer (with pending contracts) on account of illness of proprietor. A. Knancke, Box 278, AMERICAN MACHINIST.

For Sale—Sets of patterns for pulley turning and boring lathe, sizes 30", 42" and 60" with detail working drawing, and with some special boring bars and tools; these patterns were originally purchased from M. C. Hendley, Indianapolis, Ind.; a bargain for anyone who wishes to take up this line of goods to manufacture them; price $3000. Goldens' Foundry & Machine Co., Columbus, Ga.

Alphabetical Index to Advertisers

PAGE

Abrasive Material Co.....101
Acme Machinery Co..... 38
Adams Co..... 69
Albro-Clem Elevator Co..... 92
Almond Mfg. Co., T. R..... 84
Alteneder & Sons, Theo..... 38
American Emery Wheel Wks. 88
American Gas Furnace Co... 14
American Pulley Co..... 68
American Tool & Machine Co. 77
American Tool Works Co. 8 and 108
American Tube & Stamp'g Co.111
American Watch Tool Co....109
Ames & Co., B. C.....102
Armstrong-Blum Mfg. Co..... 82
Armstrong Bros. Tool Co.... 67
Armstrong College 79
Athol Machine Co..... 72
Automatic Machine Co..... 67

Backus Water Motor Co..... 93
Baird Machine Co..... 77
Baker Bros.....105
Baldwin Chain & Mfg. Co.... 92
Baldwin Steel Co..... 47
Barnes Co., B. F..... 76
Barnes Co., W. F. & John... 14
Barnett Co., G. & H...4th cover
Bartlett, E. E..... 98
Bath Grinder Co..... 9
Baush Mach. Tool Co....3d cover
Bay State Stamping Co.....100
Beaman & Smith Co...15 and 84
Beche U. Gross.....100
Becker-Brainard Milling Machine Co. 23
Bemis & Call Hardw. & Tool Co. 72
Besly & Co., Chas. H.....109
Bethlehem Fdry. & Mach. Co. 76
Bethlehem Steel Co..... 51
Bickford Drill & Tool Co..... 10
Bignall & Keeler Mfg. Co.... 78
Bilgram, Hugo..... 38
Billings & Spencer Co..... 66
Binsse Mach. Co..... 38
Birdsboro Steel Fdry. & Machine Co..... 73
Blaisdell Machinery Co..... 86
Blanchard Machine Co..... 74
Bliss Co., E. W..... 25
Blount Co., J. G..... 32
Boker & Co., Hermann..... 59
Boston Gear Works..... 90
Box & Co., Alfred..... 98
Boynton & Plummer..... 72
Bradford Machine Tool Co... 5
Bridgeport Safety Emery Wheel Co..... 89
Bristol Co.....4th cover
Bristol, Wm. H..... 38
Brown Co., H. B.....102
Brown & Co., R. H..... 84
Brown Hoisting Machry. Co. 99
Brown & Sharpe Mfg. Co. 4th cover
Brubaker & Bros., W. L.....102
Buffalo Forge Co.....4th cover
Bullard Mach. Tool Co., 37 and 108
Burke Electric Co..... 96
Burroughs Co., Chas..... 77
Burr & Sons, John T..... 78
Bury Compressor Co..... 86
Butterfield & Co..... 70

Caldwell & Son Co., H. W.... 92
Carborundum Co..... 30
Card Mfg. Co., S. W..... 16
Carpenter Tap & Die Co., J. M..... 74
Carr Bros.....103
Carver File Co..... 78
Case Mfg. Co..... 98
C & C Electric Co..... 95
Chadwick & Trefethen.....102
Chambersburg Engineering Co. 69
Champion Tool Works Co.... 78
Chicago Flexible Shaft Co.... 66
Chicago Pneu. Tool Co..... 86
Chicago Rawhide Mfg. Co.... 94
Chisholm & Moore Mfg. Co... 98
Cincinnati Ball Crank Co.... 82
Cincinnati Electrical Tool Co.113
Cincinnati Machine Tool Co. 112
Cincinnati Milling Mach. Co. 6 and 7
Cincinnati Planer Co..... 20
Cincinnati Shaper Co.....114
Clark Auto. Telephone Switchboard Co..... 71
Clark Cast Steel Cement Co.. 82
Clark, Jr. & Co., Jas.....104
Clayton Air Compressor Wks. 86
Cleveland Auto. Mach. Co.... 18
Cleveland Cap Screw Co.....102
Cleveland Crane & Car Co.. 98
Cleveland Planer Works.....109
Cleveland Twist Drill Co. 4th cover
Cleveland Wire Spring Co.... 74

PAGE

Clough, R. M..... 91
Coates Clipper Mfg. Co..... 64
Coes Wrench Co..... 26
Colburn Machine Tool Co.... 24
Cook Co., Asa S.....102
Crescent Forgings Co..... 66
Crocker-Wheeler Co..... 94
Crosby Steam Gage & Valve Co. 17
Cumberland Steel Co..... 79
Curtis & Co. Mfg. Co..... 87
Curtis & Curtis Co..... 78
Cushman Chuck Co..... 84

Dallett Co., Thos. H..... 68
Desmond-Stephan Mfg. Co... 89
Detrick & Harvey Mach. Co. 74
Diamond Chain & Mfg. Co... 79
Diamond Saw & Stamping Works 101
Dickinson, Thos. L.....100
Diehl Mfg. Co..... 96
Dill Slotter People.....105
Dixon Crucible Co., Joseph.. 93
Dodge & Day..... 93
Dreses Machine Tool Co..... 64

Earle Gear & Mach. Co..... 91
Eastern Machinery Co..... 82
Eberhardt Bros. Mach. Co... 92
Eck Dynamo & Motor Wks.. 96
Elmes Engineering Works, Chas. F..... 78
Errington, F. A..... 85
Evans Friction Cone Co..... 78
Excelsior Needle Co..... 76

Fairbanks Co.....101
Farrel Fdry. & Mach. Co..... 80
Fawcus Machine Co..... 90
Fellows Gear Shaper Co..... 92
Felton, Sibley & Co..... 76
Field, Chas. H..... 82
Firth-Sterling Steel Co..... 81
Fitchburg Machine Works... 31
Foote Bros. Gear & Mach. Co. 92
Foote-Burt Co., The.....109
Fosdick Machine Tool Co.... 16
Franklin Mfg. Co., H. H.....113
Frevert Machinery Co..... 98
Fulton Fdry. & Mach. Co.... 79

Gang Co., Wm. E..... 82
Gardner Machine Co..... 88
General Compressed Air & Vacuum Mchy. Co.....106
General Electric Co..... 94
General Pneumatic Tool Co... 99
Geometric Tool Co..... 21
Gisholt Mach. Co..... 24
Gleason Works.....4th cover
Globe Machine & Stamping Co. 82
Goldschmidt Thermit Co..... 80
Goodson Electric & Mfg. Co. 93
Gorton Machine Co., Geo.... 85
Gould & Eberhardt..... 69
Graham Mfg. Co..... 83
Grant Gear Works..... 90
Grant Mfg. & Mach. Co.....100
Gray Co., G. A..... 38
Gray & Prior Machine Co.... 74
Greaves, Klusman & Co..... 77

Hammacher, Schlemmer & Co. 51
Hanna Engineering Works... 78
Hardinge Bros..... 79
Harrington, Son & Co., Edw. 68
Harrison & Knight Mfg. Co. 78
Hart & Cooley Co..... 97
Hendey Machine Co..... 53
Henley Publishing Co., N. W. 25
Henry & Wright Mfg. Co..... 65
High Duty Saw & Tool Co... 63
Hill, Clarke & Co., Inc.....107
Hill Publishing Co.....38 and 62
Hisey-Wolf Machine Co..... 25
Hoefer Mfg. Co..... 24
Hoggson & Pettis Mfg. Co... 84
Hopkinson Machine Works... 83
Horsburgh & Scott Co..4th cover
Horton & Son Co., E..... 84
Hunt & Co., Robt. W..... 79
Hurlbut-Rogers Machine Co..114
Independent Pneumatic Tool Co. 103
Industrial Oxygen Co..... 82
Ingersoll-Rand Co..... 87
Ingersoll Milling Mach. Co....104
International Specialty Co... 88
Iroquois Machine Co..... 91

Jacobs Mfg. Co..... 85
Jacobson Mach. Mfg. Co..... 93
Jantz & Leist Electric Co.... 96
Jenkins Brothers..... 93
Johnson Mach. Co., Carlyle.. 45
Jones & Lamson Mach. Co. 12, 13 and 38

Kelly Co., R. A.....101
Kempsmith Mfg. Co..... 22
Kendrick & Davis.....103
Kent & Co., Edwin R..... 82

PAGE

Kern Machine Tool Co..... 70
Keyless Lock Co..... 78
Keystone Mfg. Co.....101
Keystone Steel Casting Co... 80
Keystone Watch Case Co....108
Kinsey Co., The E. A.....108
Knight Machinery Co., W. B. 75

Landis Machine Co..... 77
Landis Tool Co..... 47
Lapointe Mach. Tool Co..... 87
Lea Equipment Co.....105
Le Blond Machine Tool Co. R. K.....26 and 4th cover
Le Count, Wm. G..... 84
Lincoln Motor Works Co..... 96
Link-Belt Co.....110
Lodge & Shipley Machine Tool Co. 4
Long & Allstatter Co..... 76
Lucas Machine Tool Co.....112
Lumen Bearing Co..... 80
Lunkenheimer Co., The..... 93
Lyon Metallic Mfg. Co.....110

Macdonald & Macdonald.....102
Main Belting Co.....102
Mfg. Equip. & Eng. Co..... 32
Manufacturers Foundry Co... 81
Maris Brothers..... 98
Marshall & Huschart Machinery Co. 108
Mass. Saw Works.....113
McCabe, J. J....73, 100 and 106
McDowell, Stocker & Co.....108
McInnes Steel Co..... 81
McLeod & Henry Co..... 71
Merritt & Co..... 79
Merritt, Jos..... 17
Millers Falls Co.....101
Milton Mfg. Co..... 57
Miner & Peck Mfg. Co..... 96
Mittineague Paper Co.....103
Modern Tool Co..... 75
Moore Co., Franklin..... 99
Morris Fdry. Co., Jno. B..... 27
Morse Chain Co..... 71
Morse Twist Drill & Machine Co. 49
Morse, Williams & Co..... 91
Morton & Co., B. K..... 82
Morton Mfg. Co.....103
Mossberg Wrench Co..... 74
Motch & Merryweather Machinery Co.....107
Mueller Mach. Tool Co..... 71
Mumford Co., E. H..... 86
Mutual Machine Co..... 79

National-Acme Mfg. Co.....114
National Machine & Tool Co.. 78
National Machinery Co..... 79
New Britain Machine Co..... 70
New Haven Mfg. Co..... 74
New Machine Co..... 78
New Process Rawhide Co.... 91
Newton Machine Tool Works 11
Nicholls, W. S..... 98
Nicholson File Co..... 17
Nicholson & Co., W. H..... 77
Niles-Bement-Pond Co..2, 3, and 108
Northern Electrical Mfg. Co. 94
Northern Engineering Works 98
Norton Co..... 61
Norton Grinding Co..... 60
Nuttall Co., R. D..... 90
Nutter, Barnes & Co..... 21

Obermayer Co., The S.....101
Oesterlein Machine Co.....102
O. K. Tool Holder Co..... 75
Owen Machine Tool Co..... 22

Page-Storms Drop Forge Co. 79
Parker Co., Chas..... 83
Patterson, Gottfried & Hunter, Ltd. 76
Pawling & Harnischfeger.... 98
Paxson Co., J. W..... 86
Philadelphia Bourse..... 70
Philadelphia Gear Works..... 90
Pike Mfg. Co..... 57
Pittsburg Automatic Vise & Tool Co. 83
Poole Co., J. Morton..... 75
Potter & Johnston Mach. Co. 53
Pratt Chuck Co..... 85
Pratt & Whitney Co..33, 34, 35 and 36
Prentice Bros. Co..... 29
Prentiss Tool & Supply Co...106
Queen City Mach. Tool Co... 79

Rahn-Carpenter Co..... 79
Ransom Mfg. Co.....1 and 88
Reece Co., E. F..... 82
Reed Mfg. Co..... 83
Reichhelm & Co., E. P..4th cover
Reinforced Brazing & Mach. Co. 104
Remington Oil Engine Co.... 62
Rhodes, L. E..... 82
Ridgway Dynamo & Engine Co. 96

PAGE

Risdon Tool Wks..... 98
Rivett-Dock Company...3d cover
Rivett Lathe Mfg. Co...3d cover
Rockford Machine Tool Co... 75
Rock Island Tool Co..... 83
Rockwood Mfg. Co..... 99
Rogers Works, John M..... 75
Rogers & Hubbard Co..... 80
Roth Bros. & Co..... 95
Rowell Co., W. G..... 82
Royersford Foundry & Machine Co. 96

Sackmann, W. L..... 78
Safety Emery Wheel Co..... 88
Saunders Sons, D..... 74
Sawyer Gear Works..... 90
Schieren & Co., Chas. A.....102
Schumacher & Boye..... 9
Schwerdtle Stamp Co.....100
Scranton & Co., The..... 82
Sebastian Lathe Co.....104
Sellers & Co., Wm..... 28
Seneca Falls Mfg. Co..... 66
Shelby Steel Tube Co..... 77
Shultz Belting Co..... 62
Sibley Machine Tool Co..... 76
Skinner Chuck Co..... 84
Skinner Shipbuilding & Dry Dock Co. 78
Slate Machine Co., Dwight... 92
Sloan & Chace Mfg. Co..... 27
Slocomb Co., J. T..... 73
Smith Countershaft Co..... 31
Smith Fdry. Supply Co., J. D. 81
Smith & Mills..... 82
Soltmann, E. G.....103
Spacke Machine Co., F. W... 86
Spicer Universal Joint Mfg. Co. 102
Sprague Electric Co..... 97
Springfield Machine Tool Co.. 15
St. Mary's Machine Co..... 93
Standard Connecting Rod Co. 92
Standard Engineering Works.100
Standard Gauge Steel Co..... 92
Standard Tool Co.....113
Stark Tool Co..... 79
Starrett Co., L. S.....111
Steptoe Shaper Co., John.... 79
Stoever Fdry. & Mach. Co.... 68
Struthers-Wells Co..... 93
Sturtevant Co., B. F..... 25
Sweet & Doyle Valve Co..... 86

Tabor Mfg. Co..... 97
Taylor & Fenn Co.....101
Taylor-Wilson Mfg. Co..... 90
Thompson, Hugh L..... 78
Toomey, Frank.....108
Triumph Electric Co..... 95
Turner Brass Wrks..... 78
Turner Mach. Co..... 76

Underwood & Co., H. B.....100
Union Mfg. Co.....102
Union Twist Drill Co..... 55
United Engineering & Fdry. Co. 67
U. S. Electrical Tool Co..... 88

Van Dorn & Dutton Co..... 90
Vandyck Churchill Co..... 69
Veeder Mfg. Co.....103
Vitrified Wheel Co..... 89
Von Wyck Machine Tool Co. 75

Wagner Electric Mfg. Co..... 96
Walcott & Wood Machine Tool Co. 79
Wallace Supply Co.....102
Waltham Machine Wks..... 79
Waltham Watch Tool Co.....100
Ward & Sons, Edgar T. 67 and 80
Warner Instrument Co..... 75
Warner & Swasey Co.....112
Waterbury Farrel Fdry. & Mach. Co. 77
Waterbury Gear Co..... 91
Watson-Stillman Co..... 65
Wells Bros. Co..... 72
West Haven Mfg. Co...4th cover
Westinghouse Elec. & Mfg. Co. 95
Westmacott Gas Furnace Co. 82
Weston Elec. Instrument Co. 96
Whitcomb-Blaisdell Machine Tool Co. 19
Whitman & Barnes Mfg. Co..105
Whitney Mfg. Co..... 43
Whiton Machine Co., D. E.... 84
Wiley & Russell Mfg. Co....102
Williamson Vise Co..... 83
Wilmarth & Morman Co..... 88
Windsor Machine Co..... 75
Winkley Co., The..... 93
Wood's Sons Co., T. B..... 99
Woodward & Powell Planer Co. 63
Worcester Machine Screw Co.100
Wormer Machinery Co., C. C.107
Wrigley Co., Thomas..... 88
Wyke & Co., J.....103
Wyman & Gordon Co..4th cover

Yale & Towne Mfg. Co..... 98

Classified Index to Articles Advertised

Abrasive Materials

Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Cortland Cor. Wheel Co., Cortland, N. Y.
Norton Co., Worcester, Mass.
Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Globe Machine & Stamping Co., Cleveland, O.
Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Butterfield & Co., Derby Line, Vt.
Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arches, Boiler Door

McLeod & Henry Co., Troy, N. Y.

Architects

Dodge & Day, Philadelphia, Pa.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling

Baird Machine Co., Oakville, Ct.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller

Boston Gear Works, Norfolk Downs, Mass.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Belt Dressing

Cling-Surface Mfg. Co., Buffalo, N. Y.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Rhoads & Sons, J. E., Phila., Pa.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Rhoads & Sons, J. E, Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belting, Leather

Main Belting Co., Phila., Pa.
Rhoads & Sons, J. E., Phila., Pa.
Schieren & Co., Chas. A., New York.

Belting, Leather—*Continued.*

Shultz Belting Co, St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Benches, Work

Manufacturing Equipment & Engineering Co., Boston, Mass.

Bending Machinery, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machinery, Plate

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machinery, Power

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blanks, Nut and Screw

Dyson & Sons, Jos., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blowers

American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.
Soltmann, E. G., New York.

Blue Print Paper

Soltmann, E. G., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Boiler Setting

McLeod & Henry Co., Troy, N. Y.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd, John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., East Hampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co, Greenfield, Mass.

Bolt Heads

Lang Co., G. R., Meadville, Pa.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, Ohio.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Middletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Boxes, Tote

Cleveland Wire Spring Co., Cleveland, Ohio.
Lyon Metallic Mfg. Co., Aurora, Ill.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Brazing

Reinforced Brazing & Machine Co., Pittsburg, Pa.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum

See Grinding Wheels

Case-Hardening

Rogers & Hubbard Co., Middletown, Conn.

Cast Iron Brazing

Reinforced Brazing & Mach. Co., Pittsburg, Pa.

Castings, Brass and Bronze

Lumen Bearing Co., Buffalo, N. Y.
Rowell Co., W. G., Bridgeport, Ct.

Castings, Die Molded

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Keystone Steel Casting Co., Chester, Pa.
Manufacturers Foundry Co., Waterbury, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel

Bethlehem Steel Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.
Keystone Steel Casting Co., Chester, Pa.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.

Centering Machines—*Cont.*
Hill, Clarke & Co., Inc., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Bartlett, E. E., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor, Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.

Clutches, Friction
American Tool and Machine Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Woods Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic
Sturtevant Co., B. F., Hyde Park, Mass.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compound, Slushing
Warren Bros. Co., Boston, Mass.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Cambridge, Mass.
Iroquois Machine Co., Providence, R. I.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic
Link-Belt Co., Philadelphia, Pa.

Coping Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum
See Grinding Wheels.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S, Athol, Mass

Counters, Machinery
Veeder Mfg. Co., Hartford, Ct.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes
Box & Co., Alfred, Phila., Pa.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Cranes—*Continued.*
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co, New York.
Underwood & Co., H. B., Phila., Pa.

Crank Shafts
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach Co., Hyde Park, Mass.
Boker & Co., Hermann, New York
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York
Pratt & Whitney Co., Hartford Conn.
Rogers Works, Jno. M., Glouceter City, N. J.
Standard Tool Co., Cleveland,
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

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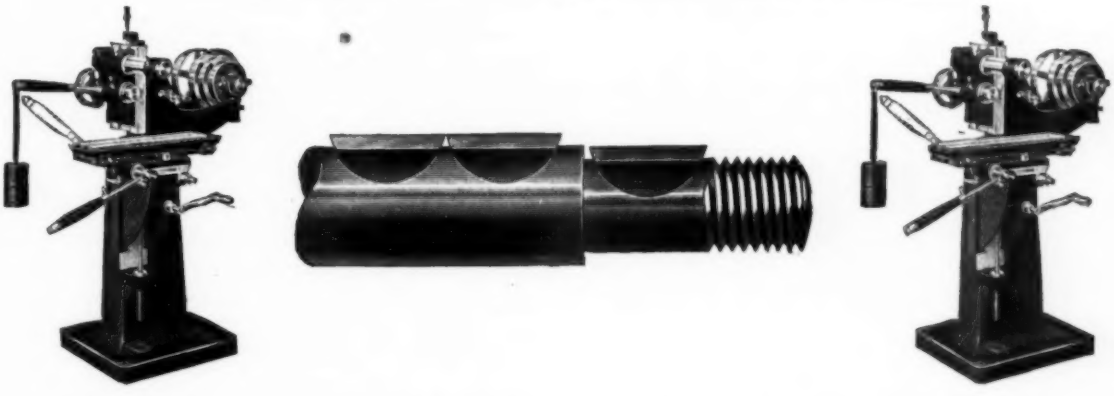

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HARTFORD, CONN.

Cyclometers
Veeder Mfg. Co., Hartford, Ct.

Diamond, Tools
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Superior Corundum Wheel Co., Waltham, Mass.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.
Risdon Tool Works, Waterbury, Conn.

Dies, Sub-Press
Risdon Tool Works, Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

Drawing Materials
Alteneder & Son, Theo., Philadelphia, Pa.
Mittineague Paper Co., Mittintineague, Mass.
Noyes Mfg. Co., Waynesboro, Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Slate Mach. Co., Dwight, Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks, Co., Cin. O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Dallett Co., Thos. H., Phila., Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric
Chicago Pneumatic Tool Co., Chicago, Ill.
Dallett Co., Thos. H., Phila. Pa.
Independent Pneumatic Tool Co. Chicago, Ill.

Drilling Machines, Multiple Spindle
American Tool Wks Co., Cin. O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.

Drilling Machines, Multiple Spindle —*Continued.*
Bickford Drill & Tool Co., Cincinnati, O.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York. delphia, Pa.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Mach. Co., Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co, Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros., Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, Ohio.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.

Drilling Machines, Upright —*Continued.*
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Coates Clipper Mfg. Co., Worcester, Mass.
Cincinnati Electrical Tool Co., Cincinnati, O.
Dallett Co., Thos., H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Clayton Air Compressor Works, New York.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
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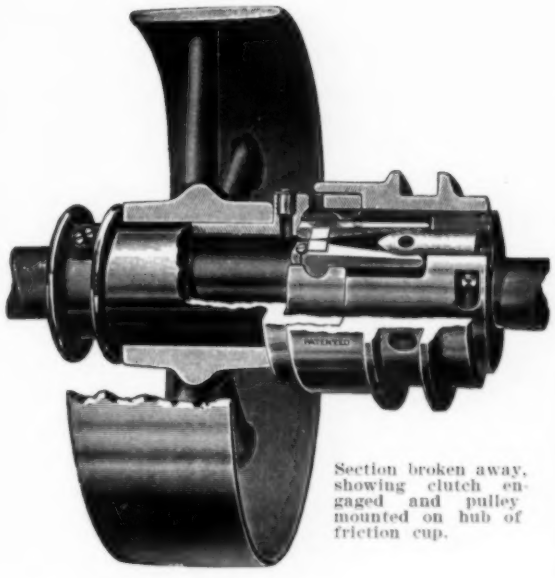
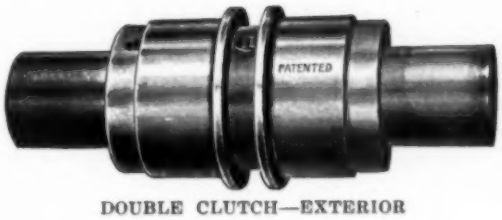
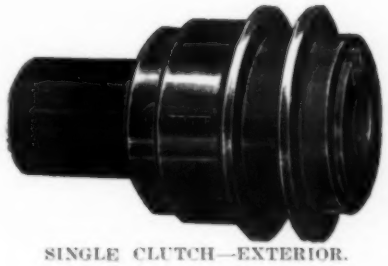


Section broken away, showing clutch engaged and pulley mounted on hub of friction cup.



DOUBLE CLUTCH—EXTERIOR



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Boston Gear Works, Norfolk Downs, Mass.
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Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
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A New Development in Air Compressors

A Machine That at Constant Speed Automatically Varies the Volume of Air Delivered to Meet the Constantly Fluctuating Demand

EDITORIAL CORRESPONDENCE

The driving of air compressors by electric motors has introduced a new problem into air compressor design. A fundamental feature of air compressor service is that the consumption of air is variable between wide limits, and the delivery of the air by the compressor must meet this condition—a substantially constant pressure being maintained while the volume of air delivered is such as to maintain this constant pressure under a constantly fluctuating consumption. With compressors having independent steam engines the requirements are naturally and usually met by varying the speed of the compressor, but with motor-driven machines this method of regulation becomes impracticable and other expedients must be resorted to, among such expedients being the use of unloading devices by which the action of the compressor is entirely suspended from time to time, and the more recent device of throttling the suction of the machine. Motor-driven compressors are now called for in considerable numbers and of large sizes, and the problem is of growing importance. The machines here shown were made by the Nordberg Manufacturing Company, the one shown in the half-tone being for the Aktiebolget Maskiniffar, Sweden, while the one from which the indicator cards were taken was made for the North Butte Mining Company. This latter machine has cylinders of 22 and 36x42 inches and a normal capacity of 3500 cubic feet of free air per minute.

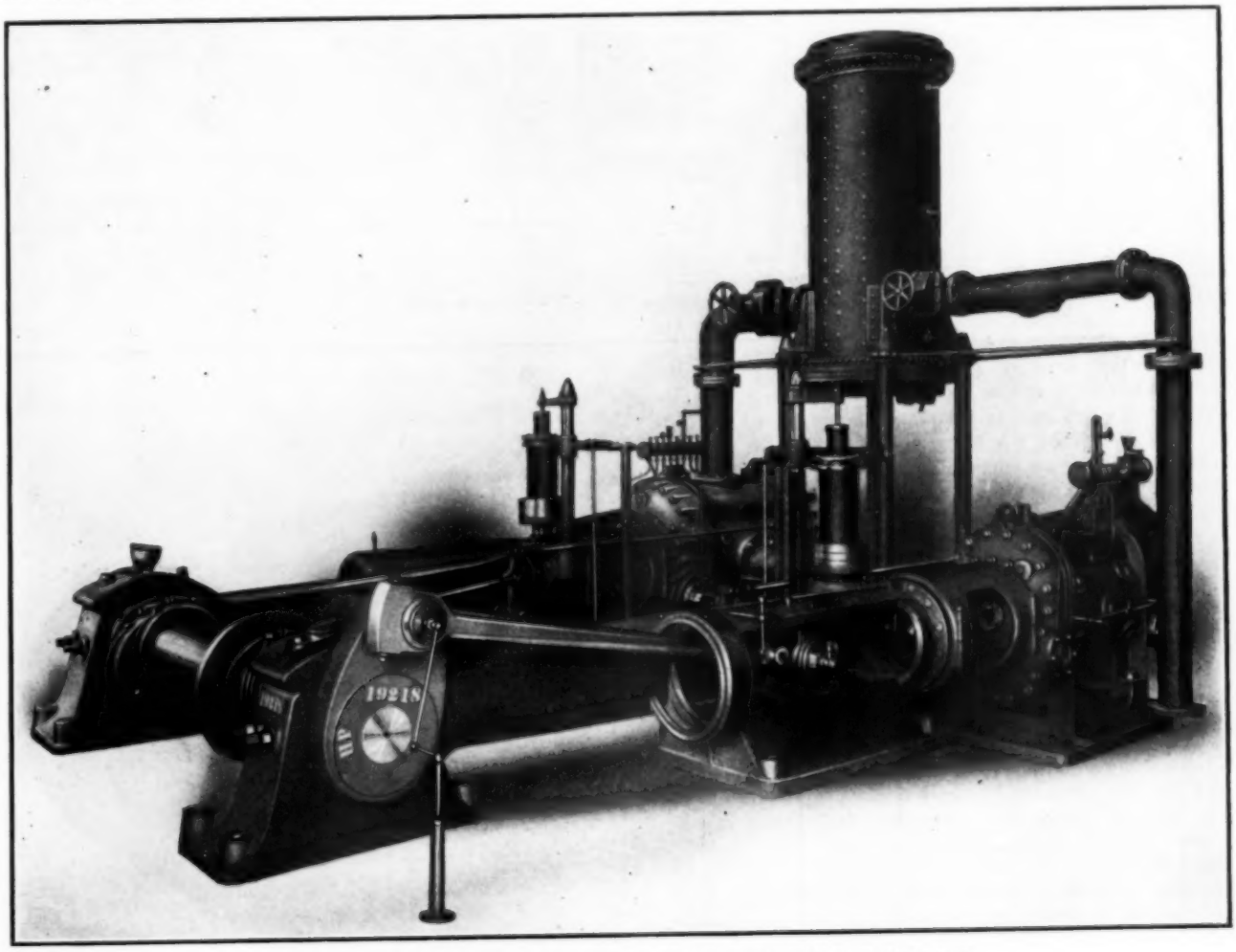


FIG. 1. THE NORDBERG CONSTANT SPEED VARIABLE DELIVERY AIR COMPRESSOR

The Principle of the Machine

The desired result is here obtained by closing the inlet valve before the stroke is completed, the air in the cylinder being then expanded below atmospheric pressure during the remainder of the stroke and compressed again during the return or compression stroke, the result being, in effect, to vary the working length of the stroke as required, the delivery of air being varied in the same ratio, while, except for possible leakage of the valves and piston, no loss is involved in the process. The valves are of the Corliss pattern actuated by the regular Nordberg full stroke gear, the closing being by a dashpot, as in steam engine practice, and controlled by a pressure governor, making the machine entirely automatic.

The Valve Gear

Fig. 1 is from a photograph of the machine, taken with the machine standing on the erecting-shop floor, and shows its general appearance. Fig. 2 is a side view of one of the cylinders, taken from between the frames, and shows clearly the general construction of the

valve gear. The wrist-plate is driven by the reach rod *a*, while the releasing gear is driven by the rod *b*, which oscillates the arm *c* about the fixed center *d*.

The two reach rods *e f* to the releasing cams, are connected to the three-armed rocker *g h i*, swiveled to the lower end of *c*, *i* being connected by the link *j* to the radius fork *k* to which the pressure governor *l* is connected. It is obvious that under the action of the eccentric rod the parallelogram of parts *c i j k* will oscillate as such, the arms *g h* maintaining a vertical position and giving equal full, one-half and nearly zero load. The compressor being compounded, the cards are double in all cases, the upper one of each pair being from the low and the lower one from the high-pressure cylinder. Fig. 5 shows the action of the gear beautifully. Taking the crank end card, the suction valve opens at the beginning of the stroke at *a* and remains open until mid-stroke is reached, when at *b* the releasing gear acts and the valve is closed. From *b* to *c* the air contained in the cylinder expands until at *c*, when the end of the stroke is reached, compression begins—the expansion and compression lines being practically superimposed until atmospheric pressure is reached, when the compression proceeds in the usual manner. The action of the high-pressure valves is precisely similar, except that the expansion and re-compression of the air is from the receiver pressure instead

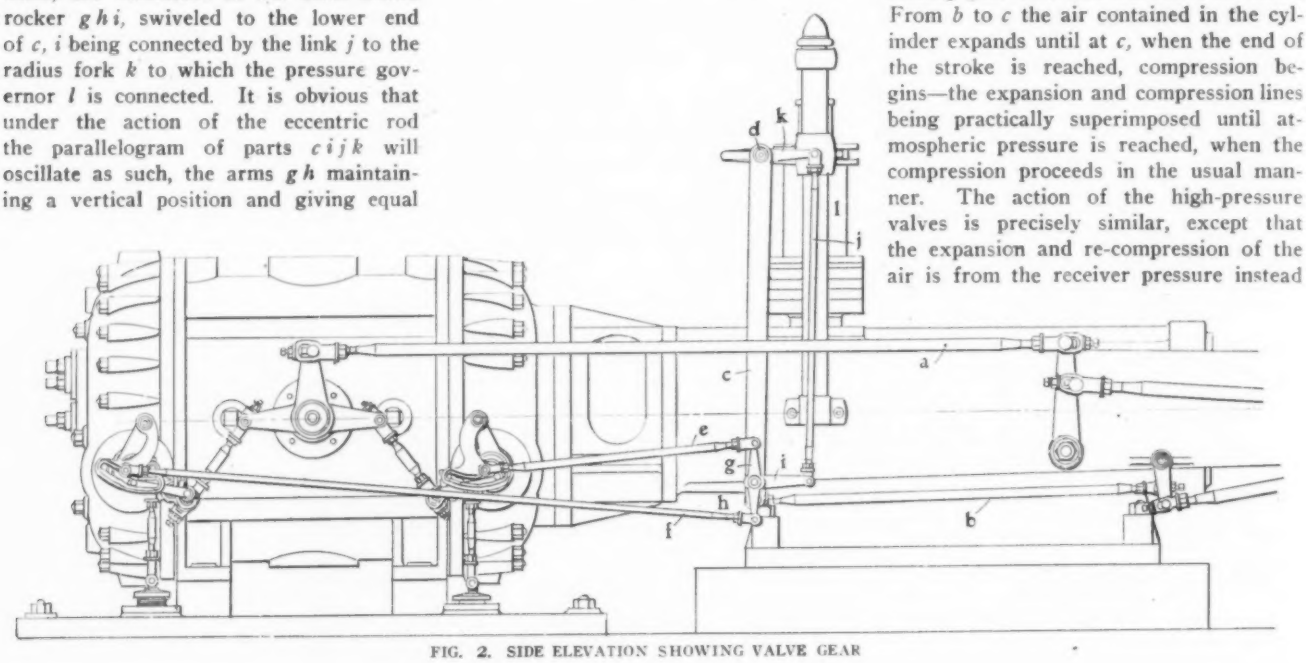


FIG. 2. SIDE ELEVATION SHOWING VALVE GEAR

movement to both knock-off cams. Should, however, the pressure governor draw arm *i* upward, *g h* will be inclined to the left and the parts will, as before, oscillate as a parallelogram, *g h* swinging in its inclined position but maintaining parallelism with itself while the two ends have again the same movement and the release of the valves is altered.

The Releasing Mechanism

The releasing gear is another beautiful piece of mechanism and is clearly shown in Fig. 3. The main valve moving piece has three arms *a b* and *c*, the wrist plate link being connected to *a*, the releasing latch *d* to *b*, and the governor cam arm *e* to *c*. The governor cam arm is connected to the governor by the rod *f* and has thus a compound motion—one by which it swings bodily about its swivel pin at the top, and another by which it is adjusted laterally by the governor. The cam arm at its lower end is composed of two circular arcs struck from the center above, the two arcs being connected by a short incline. The roller at the end of arm *g*, which is keyed to the releasing latch, rides within the cam groove as arm *g* swings under the action of the main eccentric and releases and engages the latch as the roller passes the jog in the cam groove—the position of the release being determined by the governor as already explained.

Indicator Cards

The unique action of this gear is clearly shown in Figs. 4, 5 and 6 which give indicator cards under conditions of nearly

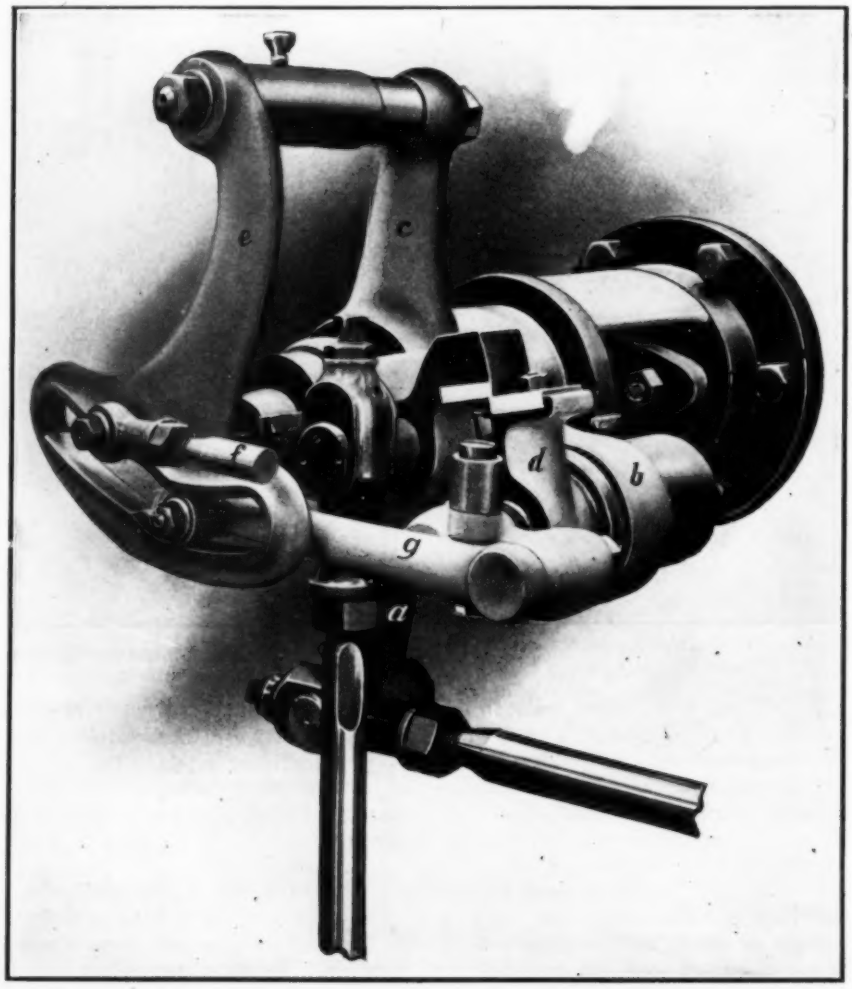


FIG. 3. THE NORDBERG FULL STROKE VALVE GEAR

of from the atmosphere. The action will be seen to be precisely the same as that of steam cylinder admission valves, opening at the end of the stroke and closing at a point determined by the governor.

In order to overcome mechanical difficulties each cylinder is provided with its own governor, and the perfection of action of these governors will be seen at once from the figures attached to the cards, giving the intercooler and receiver pressures, the extreme variation of the latter being but three pounds.

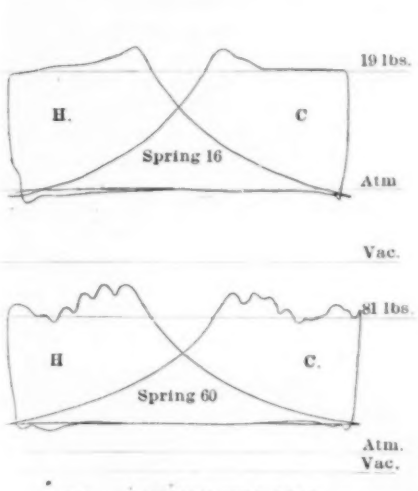


FIG. 4. NEARLY FULL LOAD

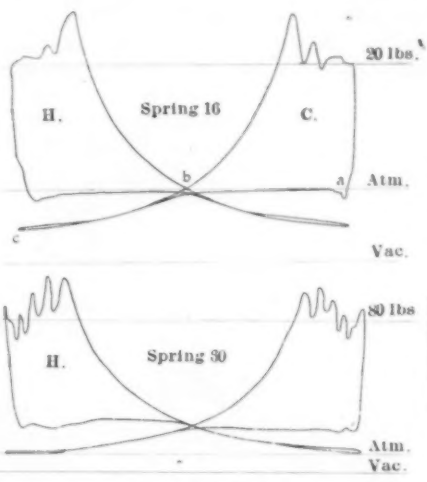


FIG. 5. HALF LOAD

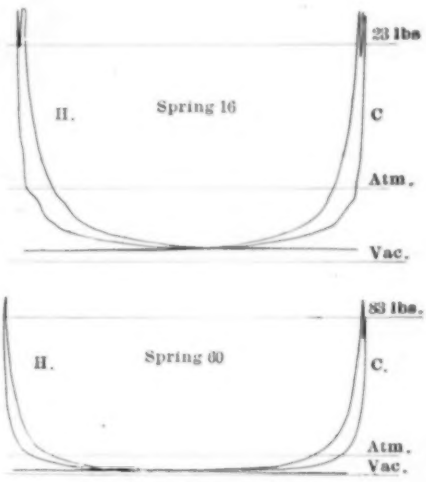


FIG. 6. NEARLY ZERO LOAD

INDICATOR CARDS. SPEED 74 REVOLUTIONS PER MINUTE

The Valves

Fig. 7 gives a section of a cylinder head and its valve. The inlet valve is shown as open, the closing movement being by a turn to the right. When closed the port *a* opens into the main port entering the cylinder, and whatever be the pressure within the cylinder, the same pressure is maintained behind the valve, which is thus prevented from lifting from its seat which, without this provision, might be the case.

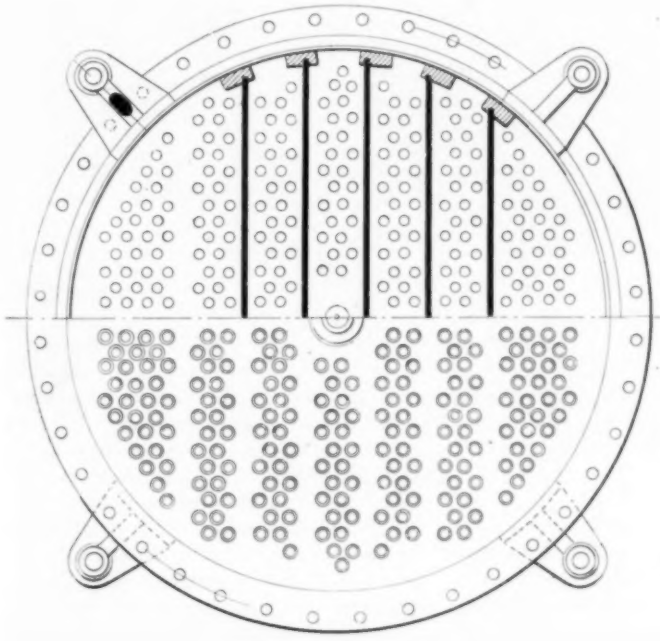


FIG. 8. PLAN SECTION

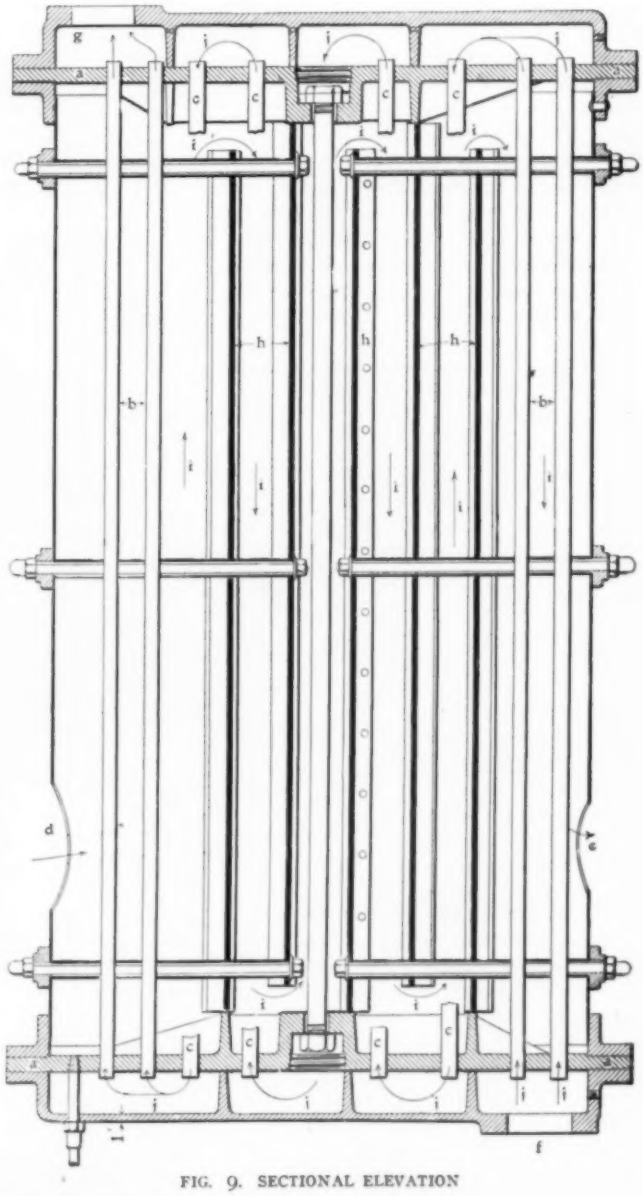


FIG. 9. SECTIONAL ELEVATION

THE NORDBERG INTERCOOLER

The Intercooler

Figs. 8 and 9 show Mr. Nordberg's latest pattern of intercooler, in which nothing has been spared to insure perfect cooling. The economy of compound compression depends entirely upon the performance of the intercooler—many compound compressors being the reverse of economical because of the imperfect action of the intercooler. The margin of gain due to compounding is not large in any event, and with some inevitable loss due to the forcing of the air through two extra sets of valves, this margin may more than disappear unless the intercooler performs its function properly, and reduces the air to very nearly its original temperature. The flow of the water and air in opposite directions through the intercooler in order that the air at exit may have the advantage of the coolest incoming water is common, but I have never before seen so complete a provision to compel the water to flow equally through all of the tubes, and thus insure that all parts of the cooling surface shall be equally effective. The tube plates are shown at *a a*, while complete tubes are shown at *b b* and others—cut off to avoid confusion—are shown at *c c*. The air enters the intercooler at *d* and is discharged at *e*, while the water enters at *f* and is discharged at *g*. Baffle plates *h h h* guide the air in the manner indicated by the arrows *i i i*, while baffles in the water heads insure the flow of the water in the opposite direction as indicated by the arrows *j j j*.

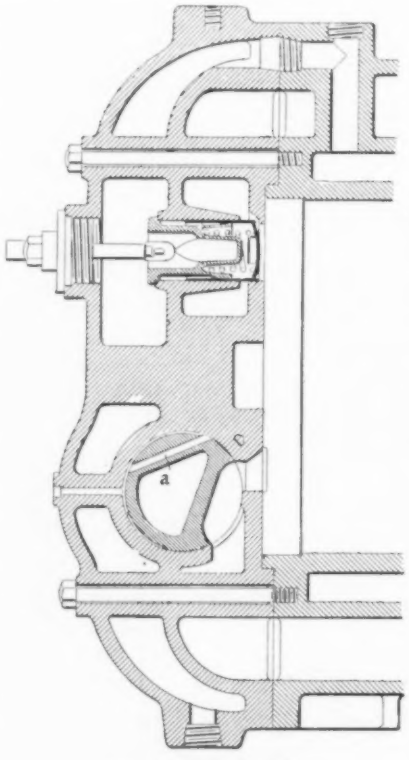


FIG. 7. THE VALVES

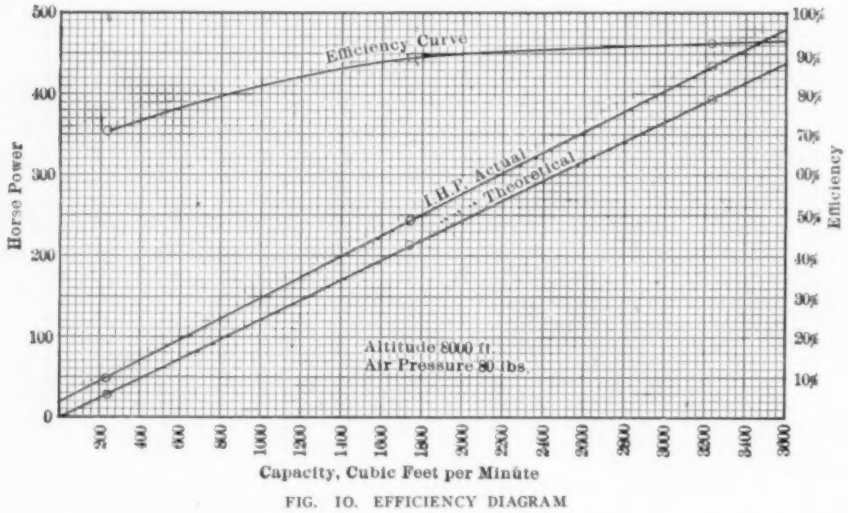


FIG. 10. EFFICIENCY DIAGRAM

Efficiency of the Machine

The efficiency of the compressor is indicated by the diagram, Fig. 10, in which the line for the actual indicated horse-power has been taken directly from the cards shown in Figs. 4, 5 and 6. The line for the theorectical indicated horse-power is based on the assumption of adiabatic compression in each cylinder, with perfect cooling between the cylinders and no valve loss—perfect intercooling being understood to mean the reduction of the air to its initial temperature when entering the low-pressure cylinder. The ratio between the two horse-powers is called the efficiency of compression and is shown in the efficiency curve at the top of the diagrams, this curve extending from an output of a little over 200 to one of 3600 cubic feet per minute. The curve will be seen to be remarkably high, and especially so for the smaller loads.

F. A. H.

A boiler-cleaning compound is being manufactured in Mexico and is reported to be meeting with considerable success. It is made wholly from vegetable substances and is said to effectually remove scale from boiler tubes while working no injury to the tubes or boiler shell.

Inexpensive High-speed Tools

By Y. Ziegler

For the past two years we have successfully used machine tools made by welding Novo steel to machine-steel shanks. Laffitte welding plate was used, and although not used on all machines these tools have given satisfaction in every way on the larger machines such as planers, vertical and horizontal mills and large turret and engine lathes.

Any style or shape can be made, and after the steel is ground away new pieces of high-speed steel can be welded on as quickly as another tool could be redressed.

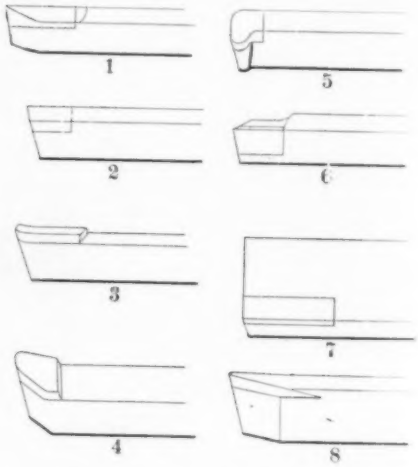
Sketches will show some of the different tools used. No. 2 is a flat finisher and can be made as shown or by merely setting steel on the upper side of the shank as the roughing tool Fig. 4.

For a side tool, Fig. 6, the high-speed steel is simply welded on the side of the shank, a piece ¼x1x1½ inches in this case being large enough.

When using facing tools made of solid high-speed steel on the horizontal mill a large per cent. would break under a heavy cut, but since making them, as in Fig. 7, we have no more broken cutters.

Facers for turret lathes, both roughing and finishing, are made in the same way. Fig. 8 is the method used in making some of the narrow tools.

Although we have an occasional poor weld, on the whole very few tools have been sent back to the blacksmith because of the Novo becoming detached.



INEXPENSIVE HIGH SPEED TOOLS

To make the weld both the shank and steel are brought to a bright red heat, then taken from the fire and a piece of the welding plate placed on the shank and the steel on the plate. A flatter is held on the steel, and a sharp blow is struck with a sledge.

They are then put in the fire and brought to a white heat, and by a few more blows are thoroughly welded.

More about Filing Systems

By A. B. James

Some years ago (American Machinist, March 13, 1890) Prof. A. T. Woods strongly advocated the envelop system of filing, giving credit for the idea to Professor Chandler, of Columbia College. Since then it has been often advocated with modifications suggested by the writer's ingenuity and the commercial use of the card index.

The greatest defect in most methods proposed is that they have been patterned after some library cataloging system. The requirements of the average working-reading mechanic are essentially different. In again advocating this system or its more recent form, the vertical file, it is assumed that a man reads a technical paper because of its value to him in his work, and that he wants this information in get-at-able form without much expenditure of time. From the standpoint of the individual, a man's time has a greater value to himself than to anyone else, and therefore the time spent on a filing system means more than day's wages. Its potential value is greater.

The big, discouraging time-wasters are clipping, pasting and card indexing; a filing system is good to the extent that these are eliminated.

Starting the Envelop System

Such a system is very easily started. Measure the largest page to be filed, decide whether it is to be folded or filed flat and buy envelops to suit. A 10x12 will take a page of the American Machinist or *Engineering News* with one fold. The heavier the envelop the better, as it will withstand much handling and rough usage. A good manila envelop can be purchased for about $3 per 100. This quantity is ample for a beginning.

Start with a subject classification. Make it up from the table of contents of the most used hand-book, or from the advertising pages of the magazine touching one's work most closely. Run over this, making a rough list of topics; give each one a number; leave plenty of gaps; this will save decimal or hyphenated subdivisions at the start. Suitable subdivisions will suggest themselves as the material accumulates, or may follow those of some text-book on the same subject. Tie the new material back into one's reference books. The periodical of today becomes the text-book of tomorrow. It is mortifying to find it working the other way—what seems to be the most recent data will sometimes be found in the books of five years ago.

FILING SYSTEM

Some Classifications Difficult

Some articles absolutely refuse to be classified in anything less than a Dewey decimal system, and it is better in this case to put them frankly into an alphabetical or into a generous miscellaneous file. It is easier and saves time to index some articles rather than worry with some involved or minute classification. Keep the index sheet in the envelop with the paper. In some cases arbitrary subdivisions are more convenient; power plants, for instance, could be subdivided by the character of the service, boiler horsepower, or type of machinery.

If one is interested in power-plant equipment, the index sheet may be so ruled as to show the entire equipment of a number of plants at a glance, and such questions as: Under what conditions are plants of less than 1000 horse-power using stokers? or, What plants are using barometric condensers with turbines? may be answered off-hand. It is the desire to answer just such suppositious questions that has led to the mistake of card-indexing everything.

Let the file be its own index. If a man asks, "What is that nice little clutch used on German paper-box machines?" it is much easier to turn to the envelop "Machine elements," and run through the section on "Clutches" than it is to look in a card index and find that the article was published at a certain time, had so many words and such a number of illustrations. It is the fact that a man wants, not the form in which it is presented.

Dividing the Papers

Some people object to dividing their papers in this way; if their point of view is accepted, the objection is unanswerable, and the card index claims another victim. Separate the paper by taking out the binding staples; file only full sheets; don't trim or cut. Cross indexing or indexing an article on the back of another one is simply done. On one margin give the number of the envelop in which the article is to be filed, on the opposite margin give the number of the envelop or subject under which it is desired to cross reference it. Take two or three months' accumulation and sort out those sheets having cross-reference numbers on them. Enter this reference on the margin of a closely-related article or on one on the same subject, before the sheet is finally placed in its proper classification. It may also sometimes happen that part of an article will be on a sheet with another classification and the remainder on a sheet in a still different classification.

Cross Indexing

As an example of the first of these cases, one sheet contained diagrams for concrete-steel beams and for the calcu-

lation of retaining walls. As the diagram for retaining walls was of more direct interest, the sheet was given the classification for "Walls," in this case 400; on the opposite margin, marked 150—1, the classification for "Calculations relating to concrete beams," and also marked 21—0, the classification for "Diagrams." A reference was made under each of these subjects. As an example of the second case, in a recent issue of *Power* an article on oil pumps was followed by a description of a barometric condenser. The following sheet contained the end of the condenser article, and one on refrigerating machines. The first sheet was filed under "Lubrication," 26, with a cross reference to "Condensers"; the bottom of the sheet was marked "continued on 56," the file number for refrigerating machinery. At the head of the second sheet was marked "Condenser, continued from 26." A cross reference was then made on an article dealing with barometric condensers, "See 26—*Power* 6/07." These illustrations show the greatest number of references required to get an article into the file.

Condensing Your Material

The steps so far indicated represent growth or expansion. The next step is to condense, or compact the material accumulated. This is best done by removing the material on a given subject from the envelop and binding it in permanent form. The ultimate aim of the system is not indefinite expansion or subdivision, but to produce a number of pamphlets, each dealing with a definite subject and covering a certain interval of time. That much of the great quantity of valuable material in a technical paper is worthy of permanent place in engineering literature is made evident by the American Machinist in the worm-gearing articles, by Halsey; the "Strength of Beams," by Guy, and the "Construction of Cams," by Moore. These all indicate the value of this method of filing. A more direct illustration is found in the supplement recently issued on Calipering, the most valuable part of which was the bringing together of useful data on fits and limit gages, which had previously appeared.

A good filing system shows the value of a good paper.

The illustrations show how the plan works out in practice, a general view being given in Fig. 1. Eleven lineal feet of shelving provide ample room for 160 envelops covering 95 subjects, and even more can be added. Fig. 2 is an example of cross-reference marking, Fig. 3 of alphabetical subdivisions of a subject and Fig. 4 of the final object of the system, i.e., collecting all information on a given subject into compact form.

In one shop a canvass showed out of 56 men taking technical journals 39 were keeping a comprehensive filing system.

Wheel-truing Fixture for Surface Grinding

By A. B. Christman

In the grinding of hardened and unhardened steel blocks and plates of various thicknesses, so much annoyance was caused by the grooves or wheel marks felt in the surfaces that it became necessary either to eliminate the trouble or to increase the allowance for lapping, which was 0.00025 inch. As each of the three machines produced different results, all equally bad, under the same conditions of speed, feed, grit, grade, and depth of cut, it was necessary to look farther for the cause.

After trying the experiment shown in diagram Fig. 1, we made the permanent fixture shown in Figs. 2 and 3.

In Fig. 1 *W* is a section of grinding wheel, with *C* as its center; *P* is the platen of the machine, and at *A* is shown the position of the diamond held in a regular screw vise (not shown) which was the cause of the trouble. At *B* is shown the correct position of the diamond, i.e., on a line perpendicular with lateral and cross-feed lines of travel of platen, and passing through *C*, or in other words, at that point of the wheel where the work is done.

Obviously, if the wheel-carrying spindle were perfectly parallel with the cross-slide and perpendicular with the vertical adjustment, it would not matter at which point of the path of its travel the wheel were trued; but as this is not possible, the wheel must be trued at its point of use. In Figs. 2 and 3, *D* is the cast-iron base or stand resting on the platen *P*, *H* is the diamond holder, *E* the diamond, *S* a set-screw, and *N* a hole for a T-bolt. In the diagram, Fig. 1, considering *P'* as the platen of a cylindrical grinding machine, it will be seen that the same condition prevails.

It is interesting to note that of two prominent makes of universal grinding machines one is arranged so that the wheel may be trued at a point on a line horizontal with its center, as at *B*, and one is arranged as at *A*.

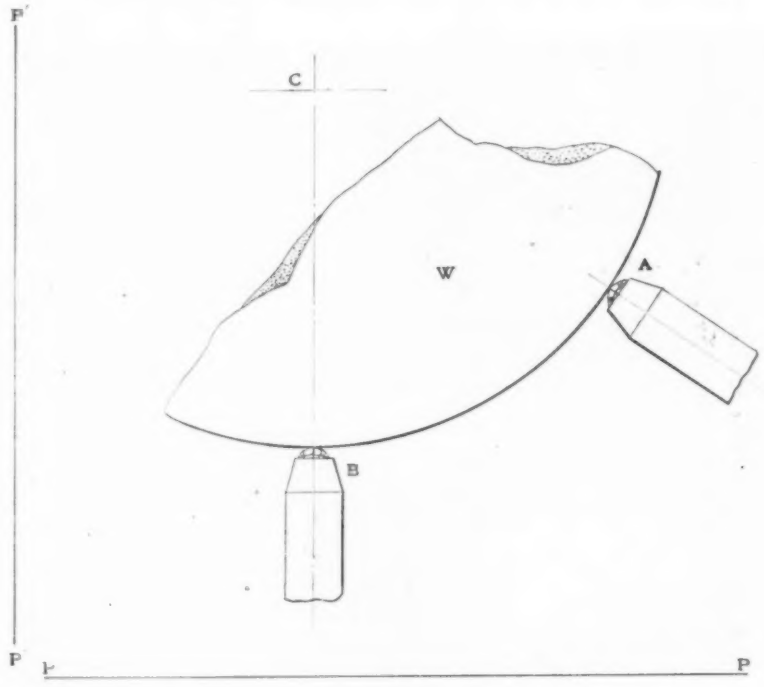


FIG. 1 FIG. 2

WHEEL TRUING FIXTURE FOR GRINDERS

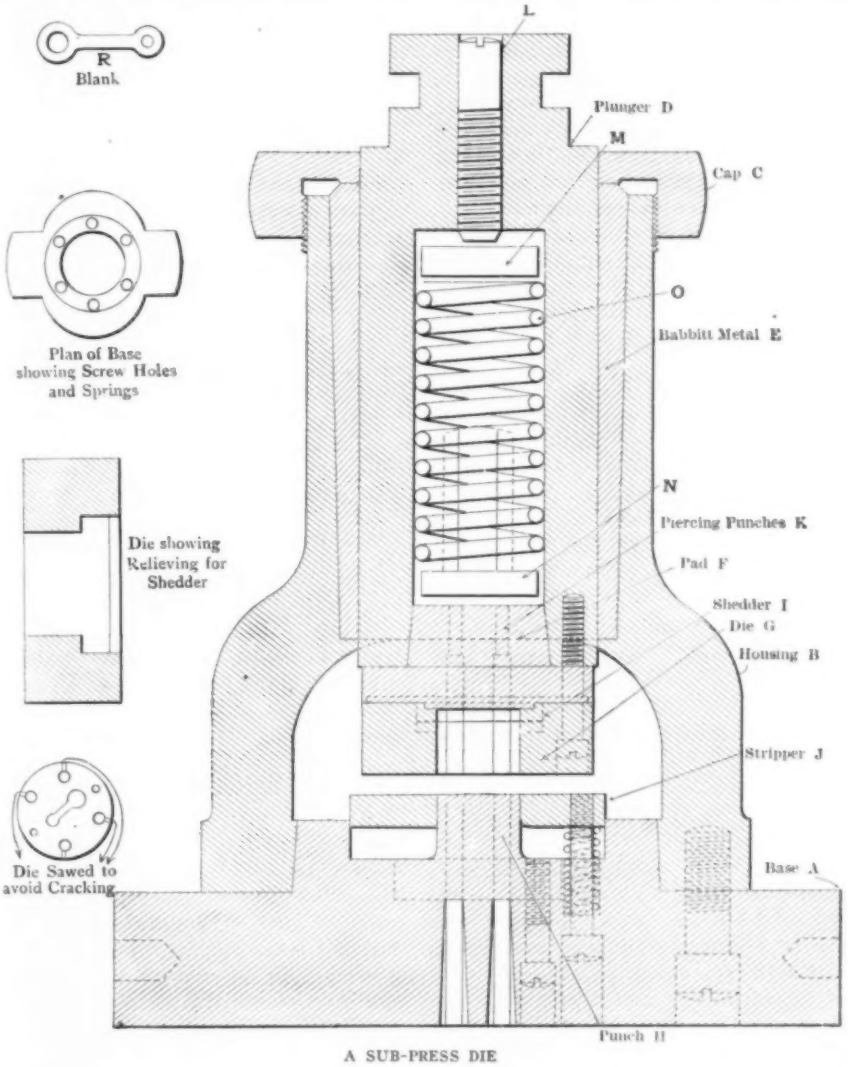
Making a Sub-press Die

By H. M. Hyatt

The construction of sub-press dies and their advantages are always of interest to many as regards the how and the why. Let us assume that we wish to produce the blank shown at *R* in the illustration, and that the model is made.

There are several methods of procedure that we may follow to accomplish the desired result; the best one must be determined to a certain extent by the workman, and by the existing conditions. In shops where these dies are made to any extent, it is customary to standardize the several sizes and proportions so that all may be kept in harmony. As we have the model, we can determine the size of the die *G*, that is, its diameter, which will correspond with the diameter of the plunger *D*. In making the die it should be filed perfectly straight and relieved at the back to receive the shedder, as shown in the illustration. After hardening, it can be stoned if found necessary.

Before going further it would be well for the workman to bear in mind that "many a nickle makes a muckle," and if we slight a little here and a little there we will have trouble as we go along, and a poor job when we are done. I believe that if a sub-press die is worth making at all it is worth making well.



A SUB-PRESS DIE

The Base

Let us now consider the base. Naturally, the first thing to do is to face the bottom. We can then turn it over and strap it to the face plate, holes having been drilled in each end, as shown, to receive straps. We can finish the turning after determining the diameter of the base of the punch, and the depth it is to enter. This is a matter of judgment, but the sizes shown in the illustration are in good proportion. We must not make the base of the punch so large in diameter that we will not have room for springs of sufficient size and strength to do the work that will be required of them; at the same time we cannot allow it to enter too far, as this would make the punch unnecessarily long and consequently more liable to break. It will be noticed that the base is turned slightly tapering, usually 1 degree, at the point where it receives the housing *B*.

The Housing

We will now take up the housing. This must be first faced and bored to fit the base. It can then be turned around and bored to receive the babbitt, at the same time cutting the thread to receive the cap *C*. Notice that this boring is also slightly tapering! The base and housing can now be put together and drilled for screws and dowels, usually two of each. The plunger *D* can now be made, and should be turned straight and ground if facilities permit. It should be milled at four irregular points with a small radius cutter making a concave groove the full length of the plunger. These will match convex projections of the babbitt and prevent a careless operator from entering it in a wrong position.

The plunger should now be placed in position for babbitting, and held central and upright by a ring fixture slipping over the top of the housing and plunger with a corresponding fixture at the bottom. A coating of black lead must be applied to the plunger, the housing warmed and the babbitting done in the usual way. Force the plunger through the housing and scrape the babbitt until a good fit is secured, that is, what we call a forcing fit.

The Punch

We can now rough out the punch, which should be a light driving fit in the base, and should be screwed and doweled into position. In some shops it is customary to make the punch and die first and babbitt the plunger in position while they are entered. There are advantages in each way; but after trying both and taking everything into consideration, the writer believes that the method described is the better. Before proceeding further with the punch it will be well to make the pad *F*. Its shank should be a tapering fit in the end of the plunger, and it should be slightly smaller in diameter.

We are now ready to fasten the die and pad on the end of the plunger, the same screws and dowels serving for both. While the base and housing are together, and the plunger in position, it is necessary to get an impression on the punch, which we will assume to be in its position in the base. This is done by coating the top of the punch with solder and forcing down the die. After working away the surplus stock we can scrape off the solder, and get the impression on the punch itself. It is then a simple matter to finish the punch. We will turn to the shedder *I*. It is sometimes advisable to make this in two parts, that is, screwing the base to the body; but in this case we could not do so as there is no room for screw holes. The shedder should be a smooth running fit in the die and must not bind. The piercing holes should now be put in the punch. They must be reamed tapering, and the base relieved for the scrap metal to drop through. Now transfer through these holes to and through the shedder and into

the pad, which receives the piercing punches. These are driven into the pad and remain stationary.

The Stripper

The stripper *J* is left somewhat larger in diameter until the stock is worked out for the punch; then by forcing it on the punch and turning it concentric with the base of the punch and to its proper diameter, which should be a running fit in base *A*, it will, of course, bring the hole in its proper position in relation to the outside diameter. The stripper can be relieved in the back to correspond to the fillet on the punch. Where an automatic feed is not used in connection with the press it will, of course, be necessary to use a stop. This must be made in such a manner that it will disappear when the punch enters the die, and the faces of the die and stripper come in contact. This is done by using either a spiral spring inside of a hollow screw or a flat spring screwed to the under side of the stripper. As the punch and die separate and the shedder and stripper perform their functions, the blank is left in the metal or stock; consequently we must use one of the pierced holes as a stopping point. The plate *M* acts as a buffer for the spring *O*, and by setting the screw *L* we can get any desired tension on the pins working against the plate *N*, and on the shedder *I*. These pins should be of uniform length and hardened. If the die has been properly made it should produce a very accurate blank with little if any bur. These two points are the principal advantages of a sub-press die, and inasmuch as it cannot be sheared it should last indefinitely with a little care.

Two large Huddersfield engineering firms are extensive users of American tools and machinery, one of them having almost 75 per cent. of such equipment. The lines used in that city include factory machinery, machine tools, structural steel, laundry machinery, hardware and tools.

Speeds on the Grinding Machine

By H. F. Noyes

The question of proper work speeds on the wet-grinding machine has always been open to discussion, and shows a diversity of practice, both among operators and in the recommendations of the machine manufacturers. This has originated in part from variations in the cutting qualities of the wheels. All operators know that wheels of presumably the same grade and grain will not always cut alike, and that different bonds often require a variation in speed; so that quite a diversity of speeds may arise, according to the kind of wheel the user has become accustomed to.

This variation in wheels is much less now than it was formerly. Within the past few years manufacturers have been able to duplicate wheels quite closely. This fact, coupled with the experience gained by the machine manufacturers themselves, has gradually crystallized the practice for general work along two lines; one is a comparatively slow work speed, with a traverse nearly equal to the width of the wheel, and uses a soft wheel and slow wheel speed; while the other involves a higher work speed, shorter traverse, harder wheel and higher wheel speed.

The question chiefly affecting wheel speed is that of safety, for it is a foregone conclusion that other things being equal, more work can be obtained with the higher speeds. Just where this speed should stop depends on the construction of the wheel, its shape and the provisions for protection. The safe limit is usually recommended by the maker. Common practice is to limit this speed to 6000 feet per minute rim speed for machine grinding. Some manufacturers of machines recommend speeds of 7000 feet, and even of 8000 feet, and as the wheels are usually tested at 9000 feet these speeds are probably not excessive, provided the wheel is a plain disk, without a recess, and of strong bond. The wheels usually used at these speeds are in connection with the second of the two practices mentioned, and are combination wheels which are harder and stronger than the wheels used for the first-mentioned practice.

It is recognized that a variation in the construction of the wheel must be made to grind different materials, and this feature will sometimes influence the wheel speed. The proper wheel for any material is usually given in the makers' catalogs. As a general proposition, however, harder materials require softer wheels. Recessed wheels, with the clamping or fastening ring located within the recess, are necessarily weaker; their speeds should be limited to 6000 feet. This is particularly the case with the thin wheels used for crank grinding, where the wheel must be of large diameter in order to gain clearance for the cheeks of the crank. For these wheels 5500 feet is probably a safer limit. All wheels should be carefully handled in being changed on the machine. Probably in the majority of cases where a wheel breaks, the real cause is an incipient crack which was caused by careless handling or by allowing the wheel to run against a shoulder when in use.

A study of the other speed conditions necessary to obtain the greatest output from a grinding machine brings out many possible combinations, and it is often hard to pick out the best without considerable experimenting. These are the items which enter into the combination; the speed of the wheel, the grade of the wheel, the surface speed of the work, the traverse of the wheel or work per revolution of work, and the depth of the cut. As stated before, the two general lines of demarcation are, a softer and usually wider wheel, slower wheel speed, slower work speed and greater traverse; as compared with a harder and narrower wheel, higher work speed and shorter traverse.

Test No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Wheel Grade	46 L	46 L	46 L	60 M	60 M	60 M	46 K	46 K	36 L	36 L	36 L	24-36 3½	36 L
Dia. x Face	10½ x 1½	10½ x 1½	10½ x 1½	13¾ x 1	13¾ x 1	13¾ x 1	13¾ x 1	13¾ x 1	17 x 2	17 x 2	19¼ x 3	21 x 3	21 x 3
Wheel Surface Speed	4950	4950	4950	6840	6840	6840	5440	6890	5340	5340	4080	5026	5026
Wheel Wear	0	0	0.005	0.040	0.050	0.055	0.020	0.025	0.003	0.003	0	0	0.032
Work Length x Dia.	10½ x 2	10½ x 2¼	10½ x 2	17 x 1¾	17 x 1¾	16¾ x 3¼	17 x 2	17 x 2	10¼ x 1½	10¼ x 1½	19½ x 3	19½ x 3	20½ x 3½
Work Material	C.I.	C.I.	C.I.	Soft Steel	Soft Steel	Soft Steel	Soft Steel	Soft Steel	Soft Steel	Soft Steel	C.I.	C.I.	Crucible Steel
Work Surface Speed	39 ft.	42 ft.	60 ft.	35 ft.	12 ft.	35 ft.	22 ft.	22 ft.	12 ft.	6 ft.	9 ft.	31 ft.	11 ft.
Trav. per Rev. of Wk.	1"	3/16"	3/16"	¼"	1"	1"	1"	1"	2"	2"	2¼"	¾"	2¼"
Depth of Cut	0.001"	0.013"	0.010"	0.004"	0.004"	0.004"	0.002"	0.025"	0.003"	0.006"	0.030"	0.020"	0.010"
Total Reduction	½"	½"	½"	1/16"	1/16"	1/16"	1/16"	1/16"	1/32"	1/32"	½"	3/32"	3/32"
Time	8 min.	5 min.	5 min.	10 min.	9 min.	20 min.	20 min.	12 min.	2 min.	2 min.	2 min.	2½ min.	4 min.
Cu. In. Material Rev. per Minute	0.5	0.8	0.8	0.3	0.3	0.26	0.16	0.26	0.31	0.31	5.5	3.5	1.8

TABLE I. TESTS OF GRINDING WHEELS

The depth of the cut bears an inverse ratio to the traverse in either case, and can be increased, in general, without changing the results, provided the traverse is correspondingly decreased. It usually happens, however, that with the same grade of wheel, better sizing conditions and less wear of the wheel are obtained by lessening the cut and increasing the traverse. These general statements refer chiefly to roughing out, and to obtaining an ordinary commercial finish. To obtain a fine finish a higher work speed and smaller traverse are desirable.

Getting to the question of actual speeds for the work in these two combinations, there is a wide latitude. The first combination uses as a basis an average work-surface cutting speed of about 20 feet per minute, and often much lower, 10 and even 5 feet being suitable in some cases for roughing out. For finishing, especially where a fine finish is required, a faster speed is desirable, up to about 40 feet, which is about the highest to be recommended for these conditions. This speed is suitable for wheels of a grade of 30 to 46 on soft steel; a harder grade is needed for cast iron. A traverse of from two-thirds to almost the full width of the wheel is suitable for these conditions.

Dia.	Nearest surface speed to								
				10ft.	20ft.	40ft.			
½"	1¼	2	3	7	12	21			
¾"	2	3	6	10	18	30			
1"	2½	4½	8	14	24	42			
1½"		4	7	12	21	35	64½		
2"		5	9	16	28	49½	86½		
2½"			9½	11	20	35	61	107	
3"			9	14	24	42	74	130	
3½"			9	16	28	50	86	150	
4"				10	18	32	56	93	172
5"				12	22	62	72	125	220
6"				16	27	49	85	149	152
7"				19	31	57	99	172	303
8"					31	55	64	112	198
9"					23	40	72	118	222
10"					26	47	80	140	243
11"					28	51	88	153	258
12"					30	53	98	171	303

TABLE II. DIAMETERS AND SURFACE SPEEDS FOR GRINDING WORK

The second combination calls for a work-surface cutting speed of 60 to 100 feet per minute, a traverse up to about one-half the width of the wheel, and a grade of wheel of 46 to 60, for the average line of work. A study of tests which were made from actual working conditions in the shop, made, however, for another purpose, will bring out some of these points. The basis of comparison was the amount of metal removed per minute. The amount of power required was recorded; one interesting point which was demonstrated was that the amount of power required to remove a certain amount of metal per minute was practically the same, regardless of the size and type of machine; that is, that the horse-power used per cubic inch of metal removed per minute was approximately the same, regardless of the machine. It was about 4 horse-power for cast iron and 10 horse-power for steel. Of course the power required to run the machine light varied with the size of the machine; but when this was subtracted, the net horse-power required for removing the stock bore a regular relation to the amount and kind of metal removed per minute.

While these experiments were made along the line of the first mentioned set of conditions, they brought out some interesting points in regard to its limitations. One of these was that for cast iron, the best results in the way of removing metal were obtainable with a slower traverse, deeper cut, and preferably higher work speed.

The conditions and results of thirteen tests are shown in Table I.

In this table compare test 1 with tests 2 and 3. These tests were taken on a small machine about 10x30 inches. In 1 and 2 all conditions were the same, except the traverse and the depth of cut. The increase from 0.5 cubic inch of metal removed per minute to 0.8 showed a distinct advantage for the slower traverse, without any particular difference in the wear of the wheel. In the third test an increase in the work speed was also made, which apparently gave the same result, but showed more wear of the wheel. Tests 7 and 8, with all conditions the same, except the wheel speed, show the distinct advantage to be gained by increasing the speed of the wheel. The speed used in No. 8 is toward the safe limit, however, considering the construction of the wheel, and would hardly be advocated for regular practice.

Experiments 9 and 10 vary only in surface speed and depth of cut. They were made on thirty pieces, and show absolutely no difference in results. The same is practically true of tests 4, 5 and 6. The fourth used a slow traverse and high surface speed; the second a high traverse and slow surface speed; the third a high traverse and higher surface speed. Experiments 11, 12 and 13, though not comparative, were made on the same machine, and show what can be done in the way of removing metal. Experiment No. 11 is a lively record.

The deductions which the writer has made from these and other experiments are, that a great number of work speeds is not necessary, provided they are arranged so that certain desirable limits can be obtained. The majority of machines on the market have from 10 to 25 speeds, according to size and make. Take, for example, tests 4, 5, 6, 9 and 10. They show conclusively that the same results can be obtained with practically a wide range of speeds, if a proper combination is made with other items. I recently had occasion to figure out a table of speeds, and have come to the conclusion that more than six or eight speeds only add to the complication of the machine without satisfying any good purpose.

Let us consider a plain grinding machine with a swing of say 12 inches. This would be considered suitable for a regular run of work up to 3 or 4 inches in diameter, and for occasional jobs of larger size. In arranging for the speeds we will assume that for each size of work from ¾ inch to 5 inches, we would like to have surface speeds of approximately 10 feet, 20 feet and 40 feet per minute. Such a range would be sufficient for all practical purposes and conform to the best practice. With six work speeds of respectively 10, 17½, 31, 54, 94½ and 165 revolutions per minute, each speed being 75 per cent. greater than the previous, we can get very close to the desired surface speeds for almost any diameter of work within the range mentioned, as shown by Table II.

Side Lights on the Shop Questions—Finishing Jigs—Relations

By R. E. Marks.

It's quite a problem to know how much finish to put on machine tools or fixtures to secure best results. I used to kick at the work our old toolmaker put on jigs and reamers, and when I got to working with him we had some hot old arguments over it. So he tried the object-lesson game on me.

I'd schemed out a drill jig for bushings and wanted to show him how cheap it could be made. When I was through with it, there weren't any lines of beauty about it, and I'll admit I was a little disappointed in its looks; but it would do the work in great shape, and that was enough. I hadn't put a file mark or a bright spot on it anywhere, not even polishing the ends of the bushings that showed.

Well, it went out into the shop and we watched it carefully. Wasn't any fault with the work it did, but the men didn't seem to care whether it was kept clean or not or whether it got an occasional whack with the hammer. One day the old chap asked me how much time it would have taken to polish the bushings and put a little better finish on the whole thing. I was forced to admit that probably a couple of hours would have fixed it up in good shape. "And do you think it paid to save two hours' time when it makes a difference in the way men handle a tool? They don't handle it as fast either."

Finishing Machine Tools

In a measure this same thing applies to lathes and similar tools. Not that all parts ought to be finished and kept polished, but a few bright spots make a pleasing relief from unfinished portions, and these should be painted often enough to keep them fresh. It also pays to have

them kept clean and free from grease, which can easily be done by allowing a man fifteen minutes to half an hour for cleaning up on Saturday.

This can probably be done a little more cheaply by regular cleaners; but where a man runs one machine fairly steadily, he takes more pride in it if he cleans it himself.

There's a certain commercial value in this as well as the moral effect of keeping things up in shape It's hard to measure in dollars and cents, but it's there just the same.

The "Relations" Disease

There's a bad case of "relations" in one shop I know of, and I believe this is one of the worst diseases that can strike any shop. If you have to support relations, put them in an asylum or turn them out to grass with an automobile or two; but don't bring them into the shop. Please note this applies only to those that can't support themselves anywhere else.

This particular case made the brother foreman, until he threw up the job as being too much to look after. Then he went to the screw department and demoralized that in various ways, principally by elegant examples of loafing and killing time. On one occasion he was located in a vacant room of the building sound asleep, and the boys quietly locked him in so he wouldn't be disturbed. It doesn't take a very vivid imagination to see the effect of this sort of thing on any shop. Men are only human, and any workman who will do his level best when the boss is a noted time killer would be next door to the angels.

It's a good sight cheaper to pay one man to stay away from the shop than to have half a hundred working even 5 per cent. below their normal output. And the example of dishonesty (for we can call it nothing else) in high places is a constant menace to the welfare of any shop.

A fully equipped modern electric car costs $4200; the old horse cars cost about $800; 40-pound rails are superseded by rails weighing from 90 to 120 pounds per yard. In New York city one can ride 37½ miles, from Battery Park to Kingsbridge, for 5 cents, by a roundabout route on the surface cars, by making use of the transfer privileges. This is said to be the record for cities in the United States, Philadelphia coming next with a 26-mile ride.

An English patent recently granted relates to the soldering of metals. For copper, brass and white metals, the flux recommended consists of a saturated solution in hydrochloric acid of one part of aluminum to three parts of zinc. For soldering aluminum, olive oil is used as a flux. The solder used in any case consists of an alloy of 3 parts tin, 1 part lead and 1 part zinc.—*The Metal Industry.*

Molding a Tapering Pipe Bend

By G. Buchanan

Fig. 1 is a view of a special taper cast-iron pipe bend. It has a 24-inch hole in the larger end, diminishing to a 12-inch hole at the smaller one; the large flange is beveled as shown. Three castings were required, which were to be as nearly duplicates as possible. The thickness of metal was ⅝ inch.

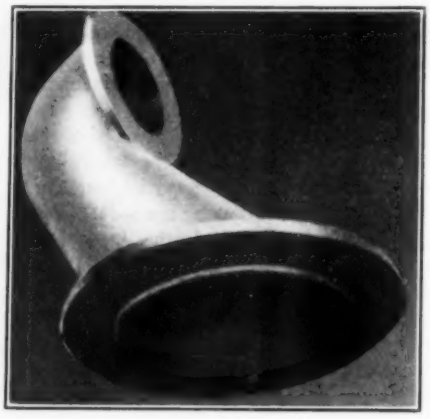


FIG. 1. THE CASTING

The difficulty experienced in obtaining an even thickness of metal in pipes of this description is well known. The usual method consists in the preparation of a skeleton pattern, from which the mold is made. The core is formed on a special plate by means of a number of sweeps and some hand shaping; or, instead of a special plate, a frame is used into which the sweeps are worked. About the same amount of hand shaping is necessary in both cases, and very often considerable rubbing has to be resorted to in order to obtain something like an even thickness of metal.

Many pieces of special pipe are successfully made by means of skeleton patterns which form both the mold and the core. In the present instance, however, a pattern of this kind would not be suitable on account of the very thin metal, ⅝ inch. A wood skeleton made up of ⅝-inch pieces would not retain its shape. The flanges would in all probability be out of true, even if a casting were obtained.

The method employed in making these castings gave good results and an even thickness of metal. The cores fitted snugly and required no rubbing. A complete mold was made in considerably less time than is usual with similar pieces made by the ordinary methods.

A metal skeleton pattern is used, made in halves, to form both the mold and the core. The wooden half pattern of the skeleton is prepared on a suitable turn-over board. After the pipe has been set out on the board, a paper templet is cut the exact shape of the pipe at the joint, so that when one-half of the pattern has been obtained the paper templet is turned over and the opposite hand marked from the templet on the board. The wooden pieces of the patterns prepared for the first half are used again for the second half of the skeleton.

Fig. 2 shows a plan and side view of the half pattern and turn-over board; *A*, *B* and *D* are half-circular pieces; *C* is a quarter-circular piece. These pieces are fastened to the board by screws from the back. All joint pieces are held in place by dowels. The parts *E*, *F*, *G* and *H* are sprigged to adjoining pieces as shown.

To mold this piece the flask is placed on the board and sand filled in and rammed

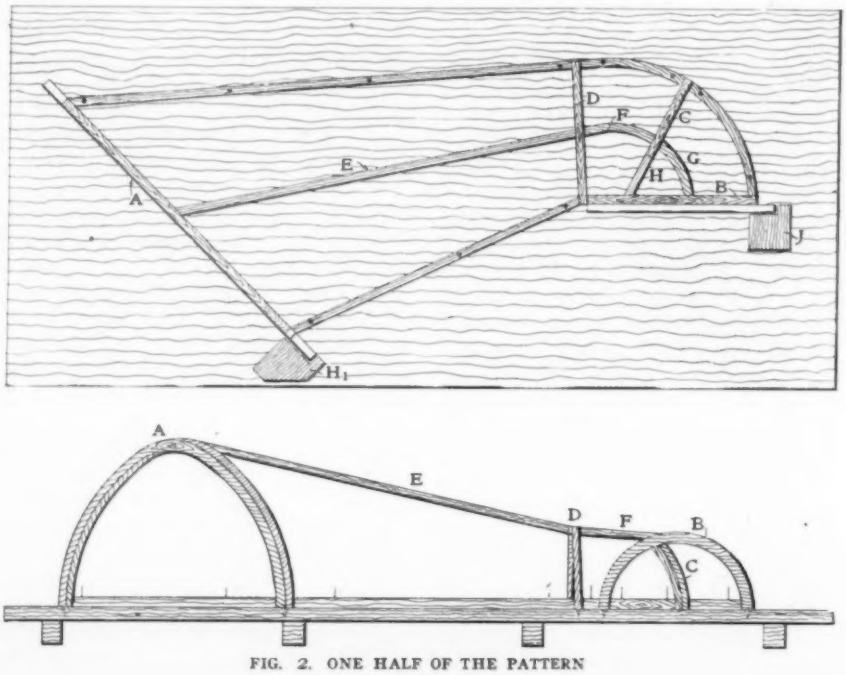


FIG. 2. ONE HALF OF THE PATTERN

until the top of the strip *E* is reached. A joint is next made level with the back of *E* and extending down to *F* and *G*. The pieces *E*, *F* and *G* are rapped and drawn and the openings covered with cores. At *F* and *G* the cores require rubbing so that they will bed on the joint, but at *E* a flat core is used. The mold is now rammed up to the top, a board bedded on, the whole is clamped together and rolled over, and the screws taken out which hold the half-circular pieces in position. The board is lifted away and a flat top rammed up in the usual way and lifted off. The half-circular pieces *A*, *B*, *D* and the quarter *C* are now turned out of the mold, all the joint strips drawn, gates cut and top closed on: this completes the molding.

The two halves are molded exactly alike and the skeletons are drilled at the openings for the fastening on of wooden flanges. The placing of wood flanges on the skeleton is necessary in order to have them perfectly true and to correct any error due to contraction or warping in the skeleton. The two halves of the pattern are located by dowels in the wood flanges. Fig. 3 is a half-tone of the pattern. The method of molding the pipe from this pattern is to first make the two half cores on any suitable plate; the half patterns being placed on the plate and the cores rammed up in the usual way, the prints are formed by the two sweeps *H* and *J*, Fig. 2. After the cores are dry the patterns are replaced on the cores and the pattern with the core inside is used to mold from. When ramming up the mold, a number of small pieces of wood 5/8 inch thick are placed in the openings between the strips of the pattern and against the core as a guide for the molder to obtain a proper thickness when finishing the mold.

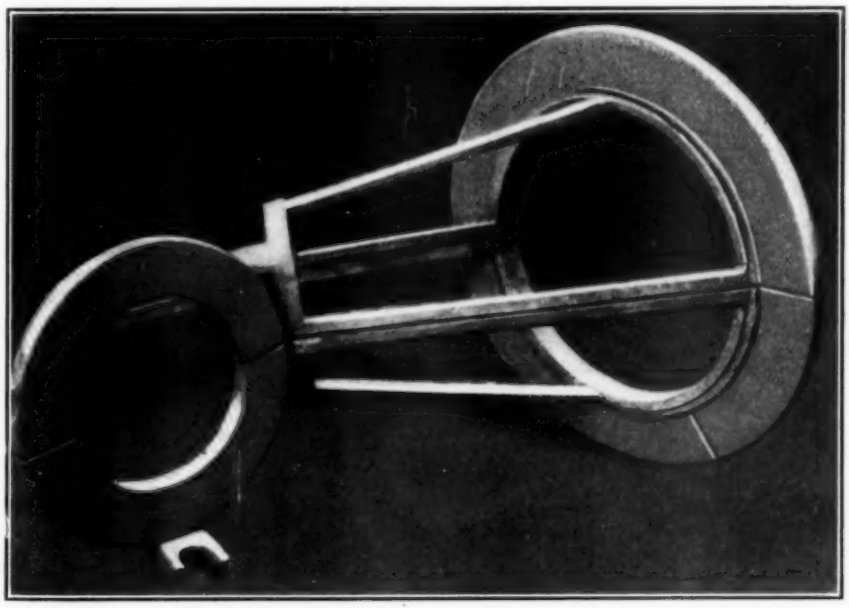


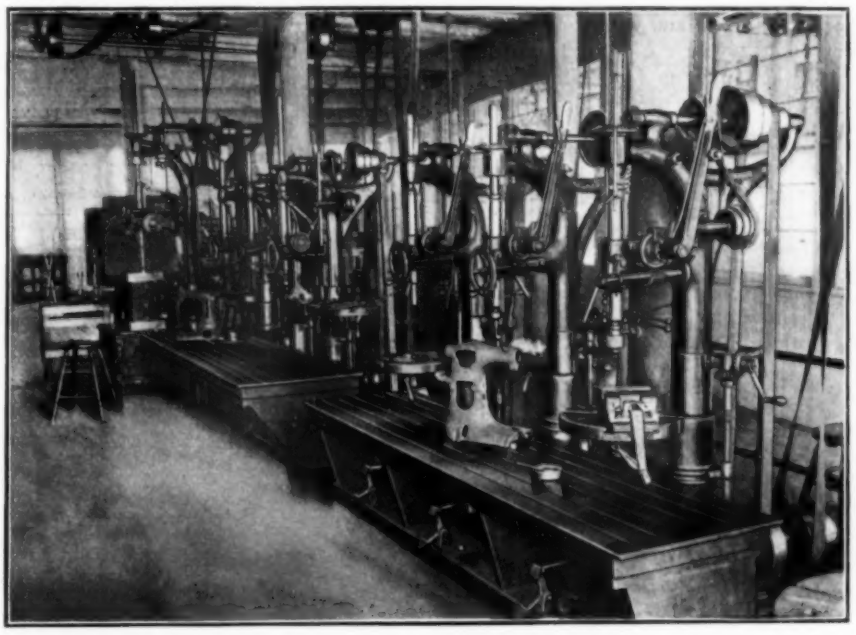
FIG. 3. THE SKELETON PATTERN

Combined Drill-press Tables

One of the interesting features in the shops of the Taft-Pierce Manufacturing Company, Woonsocket, R. I., is the combination drill table shown in the accompanying illustration. This is not a multiple-drill press, but individual drills with a common table, as shown, in addition to the round individual table of each press. The usefulness in this particular case lies in being able to slide work from one spindle to the next for different operations. This is found very handy in large jig work, or with pieces like the sewing-machine frame shown on the table or the larger work seen at the end of the second table.

The foot shifters are extended through the base, each drill being independent in every way. With this arrangement one of the group can be used with its regular table and the other two used on work requiring the combination. It makes a very flexible arrangement.

This factory is unique in that it does not market any of its manufactures, being devoted to manufacturing a number of special machines for others. It makes a number of well-known specialties, acting as the factory of the inventor or proprietor as the case may be.



COMBINED DRILL PRESS TABLE

In some cases the inventor brings his own draftsmen, works out his own designs and has the machines built the same as though the shop were his own. For this purpose there are a number of offices fitted up, each to be occupied by an inventor with his own men, with board partitions running to the ceiling, and all the secrecy that can attend such operations.

June's Steel Exports

The port of New York established a notable record during the month of June in handling 34,335 tons of the total steel tonnage of 38,641 exported by American mills during that period. The record of other Atlantic ports was: Philadelphia, 2439 tons, and Baltimore, 1867 tons. Included in the June exports were 19,021 tons of steel rails, 2422 tons of steel billets, 9045 tons of wire, nails and pipe, 4200 tons of structural, 1300 tons of bridge material and miscellaneous products.

June's record for New York is very likely to stand some time, as it will be noticed that over 89 per cent. of the total steel exports was handled through this port.

Some Automatic Screw-machine Tools and Appliances

By Conrad

The accompanying sketches show a few useful tools that can be used with an automatic screw machine. I have designed them with a view of doing the best possible work. They have been made and thoroughly tried, and give every satisfaction on a 1¼-inch Cleveland automatic. Fig. 1 shows an "up face" circular forming toolholder, for use on the cross slide. The base *A* is a steel casting and carries the adjusting plate *B*, which is also a steel casting. This plate has a number of holes drilled in a circle, which are for the pin in tool *C*, to fit into. When the tool requires adjusting after grinding, to bring the edge to the correct cutting position, it is done by means of screw *D*, which will give the full adjustment necessary between two of the small holes in plate *B*. When the limit of this adjustment is reached the tool is disengaged and turned round till the pin enters the next hole. There is no strain on the pin when the tool is cutting, as it is held either by upward pressure on the bottom of screw *D*, or by friction between tool, plate and base, caused by tightening up the nut on the end of the stud. This method of clamping has been found to give satisfaction. The flat spring *E* is to keep the plate up against the end of the screw when adjusting. A "down face" cut-off tool is shown in Fig. 2. This is of practically the same construction as the "up face" tool, the only difference being in the location of the screw *D*.

To facilitate the setting of the cutting edge of the tool to the correct hight, the simple gage shown in Fig. 3 is used. To set the tool, the gage is laid on the flat part on the top of the base *A* (as shown by dotted lines in Figs. 1 and 2). Then the top surface of the T-portion of the pin is the correct position for the "down face" tool, and the under surface is correct for the "up face" tool.

Fig. 4 shows an adjustable box tool, made entirely of steel. *A* is the body, and is bolted to shank *B*. To insure the body keeping in line with the shank it is located by a circular projection fitting in a recess in the shank. *C* is the toolholder, and *D* carries the back rests. The tool *E* is adjusted forward by the screw at the side, and is clamped by the two screws on the top. The back-rests *F* are of tool steel hardened, and are held by a screw passing right through them. Both the tool and back rest holders are adjustable on the body, and if desired, two or more tool holders can be used at one time. A slot is cut in the center of the body to allow the oil and small chips to drop through.

A hollow mill with end adjustment is shown in Fig. 5. The reason for this adjustment is to save the tool from abuse. Usually to adjust the tool out say 1/16-inch, it is knocked out with a hammer, or wrench, but with this holder, it is done by giving the adjusting nut *C* part of a turn. *A* is the mill and *B* is the holder which is split so that when it is clamped in the turret it will hold the tool as well. The pin in the holder is to keep the tool from turning round when adjusting by nut *C*. I have found that better results can be obtained with hollow mills by having rake on the back of each blade. This can be easily done on straight cut mills, by grinding a recess as shown at *D* with a small wheel. This also has a tendency to curl the chips out of the way.

A useful bar stock rack is shown in Fig. 6. It is easily made of round or square stock, and hangs on the back of the pan of the machine, with one bracket

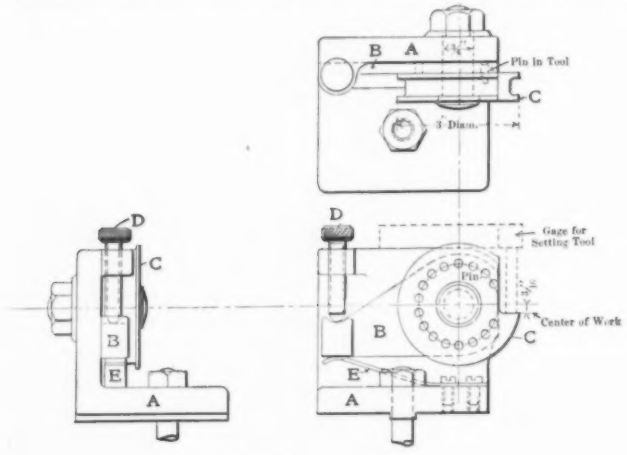


FIG. 1

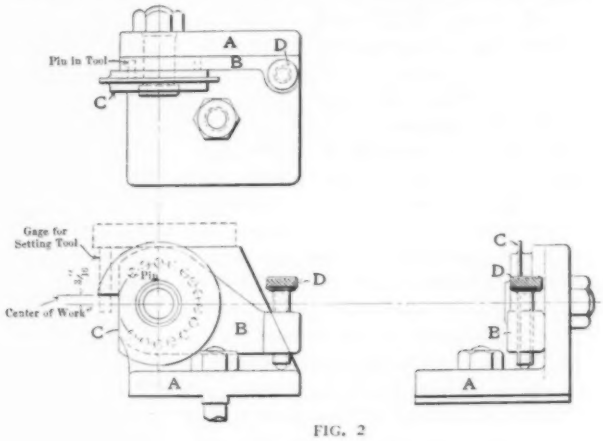


FIG. 2

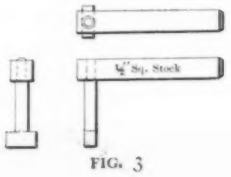


FIG. 3

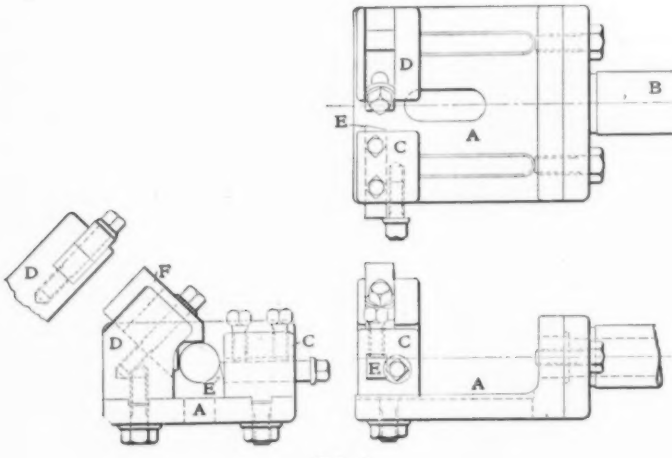


FIG. 4

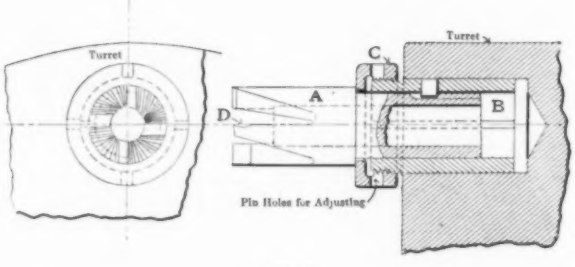


FIG. 5

TOOLS FOR THE AUTOMATIC

at each end. It is much better to keep the bars in this rack, than to have them lying round on the floor; also the material is then much easier for the operator to handle.

Fig. 7 shows a truck that was made to carry the chips, etc., away from the machine. It consists of a body, and a tray, the latter fitting into the body, and having a perforated bottom to allow the oil to drain off the chips into the body. A detailed sketch is shown in Fig. 8, and will not need much explanation. A chute detailed in Fig. 9 is fastened on to the pan of the machine by the two nurled-head screws, and the chips are raked out into the tray. After the oil has drained off, it can be drained out by means of the cock provided at the end of the body, the bottom being inclined to allow the oil to flow readily. The chute, carrier and tray are made out of No. 16 gage galvanized iron, strengthened by ¼-inch beading. The wheels and brackets are cast iron, and handles are made from 1-inch tubing, flattened at the end and fastened to body.

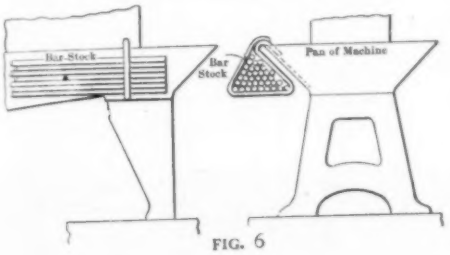


FIG. 6

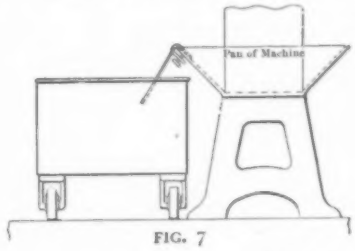


FIG. 7

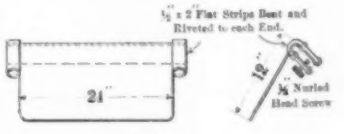


FIG. 9
Detail of Chute

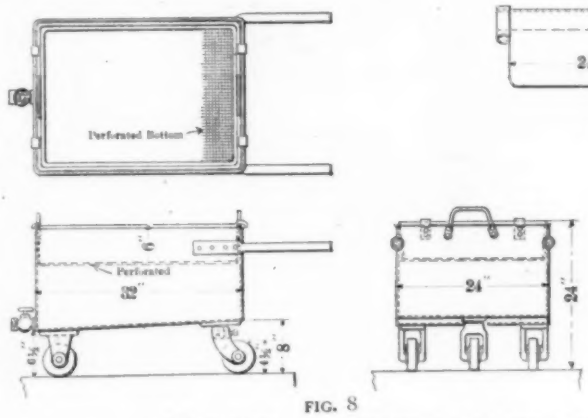


FIG. 8
STOCK RACK AND CHIP TRUCK FOR THE AUTOMATIC

Scrap in Panama

In disposing of the vast quantities of scrap along the line of the Panama canal, the Government has sold 700 old French dump cars to a Philadelphia firm for $4.15 per ton. It is estimated that each car contains about four tons of scrap. The buyer has to see to the breaking up of the cars and shipment of the material to the United States. The policy of the Government to dispose of the large accumulations of scrap along the canal line is most decidedly a step in the right direction.

Suggestions to Applicants for Positions

By H. L. Sanderson

We are undergoing another struggle to find suitable help in the drafting room, and, as usual, our experience is quite varied.

"Want ads" inserted in sundry daily papers have brought us a number of applications, both written and personal, and it is these applications and the manner in which they are made that suggest the following observations.

From our experience in this line we should say that perhaps one man in twenty knows how to apply for a position, and we suggest that prospective applicants carefully avoid the mistakes we emphasize herein.

Call in Person

Unless you are a fairly good penman, do not write your application. In any case it is much better to appear in person; but should this be an impossibility, write neatly with ink, not with pencil as some we have received, stating concisely your qualifications, experience and salary expected.

Don't say that salary is a minor consideration, for the employer knows that to be a bluff. He knows, from personal experience, that men don't work for fun and that you are working or desirous of securing work because you "need the money." You should know what the market value of your labor is and demand it.

Do not apply for a position you are not capable of filling. If you have had only one or two years' experience as a detail draftsman, you cannot expect to fill a situation as chief. On the other hand, if you have been a successful chief, look for something better rather than apply for detail work.

Don't Misrepresent Yourself

If you make a personal application, do not, under any circumstances, misrepresent yourself. Give your experience and qualifications, and in this case also be prepared to make your price and stand by it.

Be ready to give the address of some previous employer to whom you are entitled to refer your prospective employer.

One applicant I have in mind had worked for a number of firms with whom we were acquainted, but did not wish, for one reason and another, to refer us to any one of them. One firm hadn't "used him right;" another was "a mean crowd anyway, and their recommendation wouldn't amount to anything. They would give anybody one for a dollar," etc. Was he seriously considered? Well, hardly!

A Too Valuable Man

Once we asked a man if he was willing to take a temporary job, say two months, more or less, and we were nearly paralyzed by his answer. "Oh, yes!" he said, "for I know that after I have been in your employ for two weeks you will find me such a valuable man that you could not get along without me."

"Gee whiz!" we thought, "how is it we haven't gone to the wall long ago, and after we employed you, what *should* we do if you died!" All things considered we did not think it advisable to attach this human parasite to the firm. He was applying for a temporary position as detail man.

Another freak application came for the same position, through the mail. It was simply a sheet of note paper bearing in large, bold handwriting a man's name and address, and at the bottom:

"recently with S—— A——."

A Follow-up Application

In the next morning's mail came a duplicate sheet with our ad clipped from the paper and pasted in the upper corner at an angle, as if it had ben thrown there and stuck. Below appeared the same writing as previously, with the addition of the terse statement:

"A-1 Habits."

As the manager handed over this latter sheet he remarked, "I see this man has contracted A-1 habits during the night." Of course an application of that sort would receive no consideration.

In conclusion I should advise the applicant not to run down his former employers. While it may be some satisfaction to tell another your troubles, you may rest assured that it is not at all interesting to a prospective employer, and it will certainly prejudice him against you.

Aluminum Alloy Founding Practice

Mixtures Used and Precautions Taken to Insure Sound Castings in One of the Largest Foundries in the Country

BY HUGH DOLNAR

The Allyne Brass Foundry Company works about 200 men at the parent Cleveland foundry, 180 at Detroit, 125 at Buffalo and advertises itself as the largest of jobbing brass foundries.

About 80 per cent. of the Allyne product goes to automobile builders, and about 60 per cent. of the total is aluminum alloy, of which nearly all goes to the motor-car men.

Very few persons are aware of the magnitude of the brass, bronze and aluminum-alloy castings orders placed by the larger automobile makers for 1908. As an illuminating instance, the Packard, Detroit, 1908 unconditional order for castings from the Allyne brass foundry, no contingencies or provisions whatever, is for no less than 500,000 pounds of aluminum-alloy castings and 250,000 pounds of brass and bronze castings, total price nearly $450,000. The Allyne Brass Foundry Company will use during the current year from 2,000,000 to 2,500,000 pounds of aluminum-alloy ingots, purchased from the Aluminum Reduction Company of America, which has a monopoly of aluminum production at the present time. The cost of producing commercially pure aluminum has now been reduced, according to trade gossip, by increased volume of output and machinery improvements, to something like 8 or 9 cents per pound.

Late in 1900 the Gray-iron and Brass Foundry in Cleveland, Ohio, which employed E. E. Allyne as general manager and Otto F. Paehlke as head brass founder, decided to go out of business, thus leaving these two young men without positions. Half in jest Allyne proposed to Paehlke that they two, who knew each other well, should start a brass foundry together. Paehlke took the matter seriously, and as a result the Allyne Brass Foundry Company began business about January 1, 1901, with a borrowed capital of $2500, four brass molders, Pachlke himself working at the bench, and Allyne soliciting orders from the motor-car men, who were not at that date very numerous nor very strong financially, but who seemed to Mr. Allyne to need the very best bronze and aluminum-alloy castings that could be produced, and these the new Allyne Brass Foundry Company offered to make at a little above the prices charged by other founders.

At that date there was already a strong call for aluminum-alloy castings because their extreme lightness made them seem desirable to the automobile builders.

Pure aluminum is very little used in machine construction because of its weakness. It was early found that the tensile strength of aluminum castings was very greatly increased by the addition of zinc, and the first aluminum-alloy to be largely used by automobile makers was about two parts, by weight, of aluminum and one part of zinc, giving a tensile strength per square inch of section of about 35,000 pounds, with a specific gravity of 3.1, these aluminum-alloy castings being little more than one-third the weight of bronze castings from the same patterns.

Under constant vibration in motor cars the strength of this first much used aluminum alloy failed rapidly, giving several of the large motor-car builders unhappy experiences with it. This resulted in the second much used aluminum alloy, which contains no zinc at all, but adds 8 per cent. of copper to 92 per cent. of aluminum with a bare trace of nickel, and melts these metals in contact with manganese to produce the commercial ingots. This aluminum-copper alloy has a tensile strength of about 18,000 pounds, with a specific gravity of 2.84, and has the great merit of being indifferent to vibration and so "staying up" when used in trying positions. It was the first satisfactory aluminum alloy offered to the motor-car men.

FIG. 1. STEELE-HARVEY FURNACE TILTED

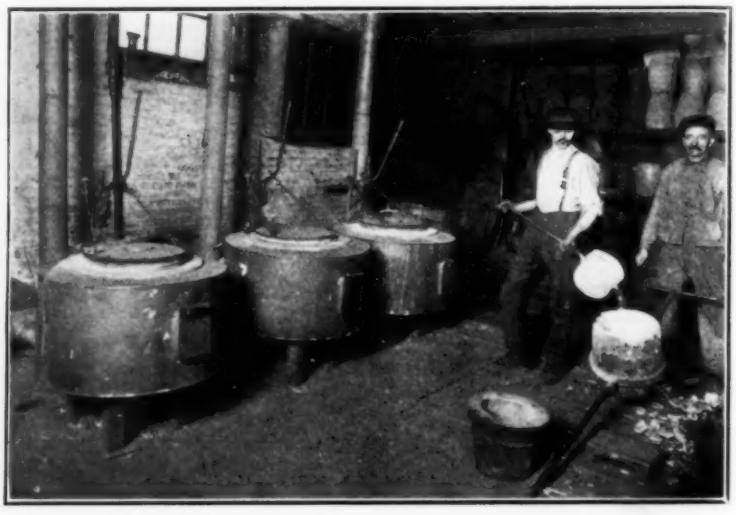


FIG. 2. JACKETED ALLYNE PROTECTED FURNACES AT CLEVELAND

The low tensile strength of the aluminum and copper alloy led to a return to zinc with only a little copper, the proportions adopted being 83 parts aluminum, 15 parts zinc and 2 parts copper. The resultant ingot has a tensile strength of 23,000 pounds, with 3.1 specific gravity. This zinc alloy is now used to a considerable extent, though many motor-car makers decline to use any aluminum and zinc alloy whatever, because of uncertainties of behavior under vibration.

The Allyne brass foundries are at the present time using exclusively the second alloy, 92 aluminum and 8 copper, with a trace of nickel.

January 1, 1901, the Allyne Brass Foundry Company had four molders in a single rented room in Cleveland, working with $2500 borrowed money; January 1, 1902, it had 60 workmen, and was using its own capital; January 1, 1903, it had

bought two acres of ground in Cleveland and was working 100 men, and in the course of that year built a new brick shop on its own ground and moved into it, so that January 1, 1904, found it working 125 hands in the new Cleveland foundry, and January 1, 1905, the Cleveland workmen numbered 150, and the company had bought ground and begun the erection of the Detroit plant, so as to be close to the Michigan and Indiana motor-car makers. January 1, 1906, it was working 160 hands in Cleveland and 125 in Detroit, and during 1906 it took over the Liberty Brass Foundry of Buffalo, so that on January 1, 1907, the pay-rolls carried 200 names at Cleveland, 180 at Detroit and 125 at Buffalo.

In 1901 the Allyne Brass Foundry Company paid for its aluminum-alloy ingots 33 to 34 cents per pound, and sold its castings at 75 to 90 cents per pound.

The ingot price fell subsequently as low as 31 cents, and the prices of castings dropped to 55 to 60 cents.

In the present year, 1907, the motor-car demand for aluminum-alloy castings has been so active that the same alloy ingot price has been advanced to 45 and 46 cents, and the price of aluminum-alloy castings is today from 67 to 75 cents per pound, and the present supply of aluminum alloy is not equal to the demand.

Use of Aluminum Alloy

While the use of aluminum alloy in high-class motor cars generally is very large and almost universal, there are yet some makers of really first-class automobiles who refuse to employ aluminum alloy in any form, claiming that pound for pound aluminum alloy has no more strength than can be had by skilful designing with high-class bronzes of 80,000 pounds or so tensile strength, and that the stronger and heavier metal is the preferable material, as it is much less easily dented and holds screws far better than the weaker white metal.

Aluminum-alloy Car Bodies

Whatever may be said of aluminum alloy for stationary parts of motor cars, such as crank boxes, gear casings and so on, there is little doubt that aluminum castings make extremely good car bodies. The finest car bodies made of wood are very expensive affairs, a high-class limousine body costing $2000 or even more.

A very large and fine seven-passenger touring-car tonneau body, made in five pieces of aluminum-alloy castings, costs a little more than $300. A similar form of

FIG. 3. ALLYNE PROTECTED FURNACES AT DETROIT

wooden body, ready for upholstering, can be had for $160 to $180, but the aluminum body takes paint better, never shows cracks from shrinkage or pounding on rough roads, and is not so severely damaged by accident as the wooden one.

The Final Verdict

Whatever the final verdict of the chassis builders may be, it seems that aluminum alloy motor-car bodies must be very large ly used.

The aluminum motor bases, oil pans and gear cases show no signs at all of going out, and the motor-car sales agent is very pronounced in his advocacy of aluminum alloy. There is a widespread belief that when the present controlling basic patents expire, the price of aluminum-alloy castings will drop to 25 cents or so per pound, and taking everything into consideration it seems that the use of aluminum alloy in motor cars is very likely to increase rather than to suffer any diminution, no matter how well founded the objections of the few builders of good cars who now decline to use aluminum castings for any purpose whatever may be.

Aluminum in the Foundry

Foundrymen like to work in aluminum alloy because of its light weight, which makes pouring off easy work, and the low fusing temperature, about 1100 degrees, which makes the aluminum foundry comparatively cool. Besides the light weight and low heat, aluminum alloy is clean when melted and does not give off those unpleasant green fumes which make a brass-foundry atmosphere almost unbreathable at pouring time. All these things make molders like to work in aluminum alloy.

Sound Aluminum-alloy Castings

Aluminum-alloy castings as first supplied had a notable and highly undesirable characteristic blemish in the form of great numbers of very small blowholes just under the skin of the top surfaces of the castings. No venting seemed to efficiently prevent these, which made it almost impossible to accurately locate drilled holes in aluminum-alloy castings.

These blowholes made such a serious blemish in aluminum-alloy castings, in spite of the very best that the moldmakers could do in the way of venting, that Mr. Allyne, who followed his castings carefully through the machine shops of his customers, had his attention strongly directed to the great desirability of absolutely sound and solid aluminum-alloy castings. Finding that no venting would do away with the small bubbles of gas concealed just under the top skin of his castings, he began an earnest search for

FIG. 4. CLEVELAND FOUNDRY, DRYING CORE WITH BLOW PIPE

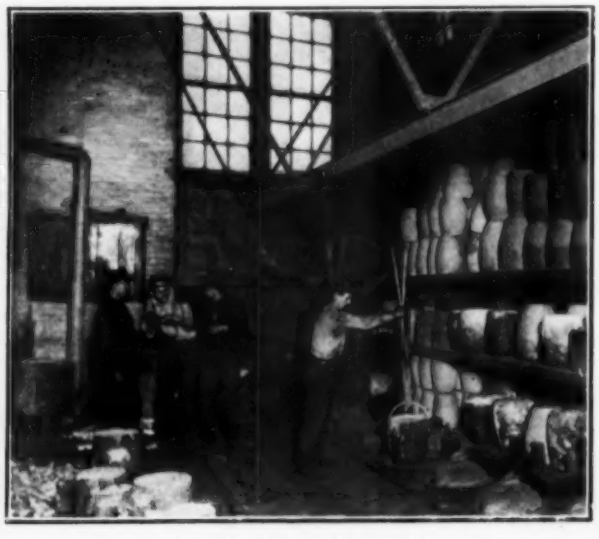


FIG. 5. LIFTING POT WITH VERTICAL HOIST

the cause of these blemishes in his principal product.

Aluminum Melting Furnaces

The brass founders were the first to supply aluminum-alloy castings, and very naturally they melted the aluminum-alloy ingots in their regular sunken air furnaces, in which 72-hour coke was used to heat Dixon crucibles. This regulation form of air furnace freely exposes the top of the melted metal in the crucibles to the escaping products of combustion. The regular procedure with aluminum alloy, after melting, is to lift the Dixon pot out of the furnace, stand it on the grating, throw a handful of coarsely-powdered sal ammoniac on top of the melted alloy, and then skim the resulting dross off with long handled steel scrapers until the metal looks clean and free from oxide. This does not prevent blowholes in the aluminum-alloy castings.

The Steele-Harvey Furnace

When the Allyne Cleveland shops began to make cast-aluminum bodies largely, a Steele-Harvey tilting furnace, which takes a stationary pot holding about 500 pounds of melted brass and is tilted to pour the melted metal from the furnace pot into the pouring ladles, was installed. The top of the stationary pot is set a little below the top of the Steele-Harvey furnace body, which is covered with a horizontally-swinging fire-brick top, having a feeding hole in the middle, covered by a molded plumbago cover, all as shown in Fig. 1. This furnace is fired with natural gas and compressed air at about one pound pressure, the products of combustion escaping underneath the fire-brick swinging cover and the top of the furnace body, thus giving but little access of the products of combustion to the top surface of the molten aluminum alloy in the pot. It was at once noticed that aluminum-alloy castings poured from the Steele-Harvey tilting furnace had fewer blowholes in them than those poured from pots heated in the regulation, sunken, coke-fired furnaces.

FIG. 6. MOLDING A TONNEAU BODY REAR SEAT

The Allyne Protected-pot Furnaces

Mr. Allyne concluded that the melted aluminum alloy absorbed the products of combustion in some unexplained manner, and that if the furnace were so constructed that the products of combustion could not touch the top of the melted metal in the pot, the castings would come sound, with no blowholes at all.

The elevated furnaces shown with jackets in Fig. 2 from the Allyne Cleveland shops, and without jackets in Fig. 3, from the Allyne Detroit shops, were built to Mr. Allyne's order from his own sketches. The gray-iron furnace body, having an open top and an integral bottom, is lined with fire brick and takes a flanged gray-iron melting pot, the pot flange completely covering the open furnace body top. Exit for products of combustion is provided by many steel-tube nipples tapped into the furnace body, close to the top, these nipples taking elbows pointing downward. This Allyne protected furnace is fired with either natural gas or illuminating gas and compressed air at one pound pressure, the same as the Steele-Harvey furnace. The top of the pot is covered by a horizontally swinging fire-brick lid, closely fitted, so as to protect the top of the molten aluminum alloy from the atmosphere, while the top flange of the gray-iron pot keeps all the products of combustion below its under surface. The Cleveland Allyne protected furnaces, Fig. 2, have exterior sheet-metal jackets applied, covering the flue elbows and connected with flues to the outside of the factory building. The Detroit furnaces, Fig. 3, have not yet had these exterior jackets applied, although the jackets are made, and discharge the products of combustion into the air of the room, which is, of course, well ventilated by movable portions of the skylights. The exterior jackets are supposed to save some fuel, but are added mainly to carry the products of combustion through special flues to the open air, instead of discharging into the shop.

FIG. 7. CORE-ROOM DETROIT SHOPS

Sound Castings Obtained by Use of the Allyne Protected Furnaces

It will be observed that it was Mr. Allyne, not himself a practical molder, who suspected that the melted aluminum

alloy absorbed the products of combustion, which does not seem probable, and it was very greatly to the satisfaction of this gentleman when the correctness of his theory was proved by the complete soundness of the castings poured from metal melted in the protected furnaces, which were first employed about nine months ago, and have never before been illustrated and described in any publication.

The value of this protected furnace is now regarded as fully proved, and all aluminum alloy will be melted in these furnaces in the three Allyne foundries as soon as the necessary additional protected furnaces can be placed.

The Allyne Brass and Bronzes

The Allyne foundries are now making large quantities of brass and bronze castings to various formulas, including many orders for the widely approved "Parsons" bronze, purchasing this metal in ingots from Cramp, of Philadelphia.

Aluminum-alloy Foundry Notes

Bars and plates which can move freely in cooling shrink about 3/16 inch to the foot. Thin shells of aluminum alloy cast over large cores shrink about ⅛ inch to the foot. The Allyne cores are made the same as for brass, with rosin, but are made to crush more easily for aluminum alloy than for castings of stronger metals.

The molding sands used are from the Buckeye Sand Company and the Paynesville Sand Company, both of Ohio, and a finer sand from Windsor Locks, Connecticut.

The Allyne protected furnaces use gray-iron melting pots, which are stationary, and have a life of about 90 hours of work, the melted metal being dipped out with hand ladles and poured into the carrying pots, as shown in Figs. 2 and 3. The average life of Dixon crucibles in the sunken air furnaces, pots lifted out for pouring, is about 35 heats.

The Allyne Pot Lifter

To facilitate lifting the large Dixon pots from the sunken furnaces, Mr. Allyne devised the traveling straight vertical lifter, shown in Fig. 4. The head of the lifter is the segment of a circle, fitted with a chain and hook, and the lifter is journaled in a block which travels on an I-beam the whole length of the bank of 20 furnaces. Two of these lifters are used, one standing at each end of the I-beam when not in use. The tail ends of the lifters are formed with three branches, to give a capstan-wheel lift.

The illustrations are from photographs by Goldman, of Cleveland, made without posing or interrupting the workmen.

FIG. 8. CLEANING ROOM AT CLEVELAND SHOPS

Fig. 1 shows the Steele-Harvey furnace tilted to pour melted aluminum alloy into a carrying pot.

Fig. 2 shows the Cleveland Allyne protected melting furnaces; the melted metal is dipped from these furnaces with hand ladles and poured into the carrying pots.

Fig. 3 shows the Detroit Allyne protected furnaces, which have not had the outside jackets applied.

Fig. 4 is from the Cleveland foundry, and shows a boy drying black-washed cores with a natural-gas torch.

Fig. 5 shows lifting a pot from an air furnace with the Allyne vertical hoist.

Fig. 6 shows molding a motor-car tonneau-body rear seat; the molder is slicking the drag; the cheek of the mold stands on horses at the left, and part of the cope is seen on horses at the right. The workman who is seen in the middle distance cleaning a seat casting is sawing off a gate with a carpenter's wood-saw.

Fig. 7 is from the Allyne Detroit core room, showing coremakers at work.

Fig. 8 is the Cleveland castings-cleaning room.

American Machinery for Egypt

By F. C. Chappell

It is impossible to ignore the remarks made by Captain Kennedy, director of the public works department, Soudan, which are embodied in the official report of Lord Cromer on Egyptian affairs. The writer states:

"As regards American machinery, a certain amount of special plant has been received from U. S. A., and this, though excellent in design, has been in every single instance of an inferior quality structurally. For example, some well-boring plant—of the American oil-well type—though admirably designed, was of the very worst description, with faulty castings and bearings and unfinished machine work. Some steam road rollers, also, designed for special work, were found to be manufactured and finished in a manner that certainly fell far short of the ordinary British standard. In consequence of this it has in some cases been found advisable, in the case of special plant of American types, to obtain the detailed designs from America and have the manufacture of the same carried out in England."

Now this is the deliberate opinion of a responsible official of very considerable experience, and it would be unwise for American manufacturers to ignore the statements. Captain Kennedy is equally severe on British methods, but in a different direction. For instance, writing about English ways of tendering, as contrasted with the methods of Continental firms, he says: "I had occasion to call for quotations for steel water towers for the storage of water for a town supply. Of two quotations which were received from British firms, one was forwarded with a drawing showing a water tower and tank of a design antiquated in the extreme, evidently copied from an old catalog, and quite unsuited to local conditions. The other British quotation was accompanied by a design for a tower which was structurally faulty, and which could not therefore be accepted. As a contrast to the above, the two quotations received at the same time from Belgian firms represented in Egypt were for water tanks and towers designed in a thoroughly practical manner, up to date in all respects and suited to local requirements."

It is easily seen from the criticisms quoted that the strictures made are quite impartial, and English firms are as badly hit as American, only the faults are different. I am pointing out these facts to American firms because the Egyptian market is really worth looking after. It

is an increasing one, a profitable one, and a fairly safe trade. Under such circumstances it certainly seems reasonable to cater for the wants of the public. I would particularly draw attention to the necessity of having a good technical representative in Egypt, a man who is a capable engineer, a good business man, who can quote prices at once and supply details without having to write home for instructions.

American locomotive builders should note the fact that traffic on Egyptian railroads has increased to such an extent that engines which a few years ago were powerful enough to cope with the work are now found to be quite inadequate for the required haulage. Pumping machinery is considerably in demand, also threshing and grain-cleaning machines, railroad stock, machine tools, files, hammers, and a variety of such goods. Agricultural machinery has been used at the agricultural college, Cairo, and other state depots with encouraging results, and it is to be hoped that many native proprietors will soon adopt it. English, American and French machinery is at present competing for public favor. Belgian and American competition is very keen in the market for ironwork for roofs, bridges, and all similar undertakings. There is not very much difference in quality, including British work, and tenders are usually decided on the question of price and time. American bridge designs are better suited to Egyptian requirements than are certain other products. One of the most important things to remember is punctuality in delivery. If American firms will guarantee prompt delivery and agree to a penalty clause in default, many more orders might be given to them. Very few British engineering firms will do this. No matter how long a time may be allowed, they will rarely go beyond the promise to "do their best." When once an order has been obtained, the time of delivery seems to be a matter of indifference. Many orders are thus lost to them. Delays in the arrivals of machinery are of obvious importance to customers who are erecting new works, as they greatly increase the general expense. As already noted, American engineering firms should be represented in at least one Egyptian city by a really competent engineer and business man combined, and a man who is also conversant with Egyptian wants. The local agents need not, of course, be up to such a high standard. It is not advisable that such agents should at the same time represent Continental firms dealing in the same class of goods. Catalogs should be issued with metric and English figures, and any drawings or plans should be quite accurate and up to date.

As regards terms of business in the engineering trade, I may state that formerly they were: One-third of the purchase money with the order, one-third after six months from delivery, and the remainder by a twelve months' bill. But present-day terms are rather more liberal. The engineering trade has felt the stress of competition very keenly and credits have increased accordingly. Nowadays the buyer has anything from six to nine months in which to pay the second one-third instalment, and from twelve to eighteen months for the balance. In special cases payments are extended for as long as two years, but in such instances interest from 7 to 9 per cent. is charged. Before allowing credit, exporters must of course take all reasonable means to satisfy themselves as to the standing of their clients. This can be done in the case of firms established in Egypt through one's agents, or, if the exporter has not such means of information, an inquiry should be put through the Chamber of Commerce, while no doubt the United States consular officers would answer such questions. F. C. C.

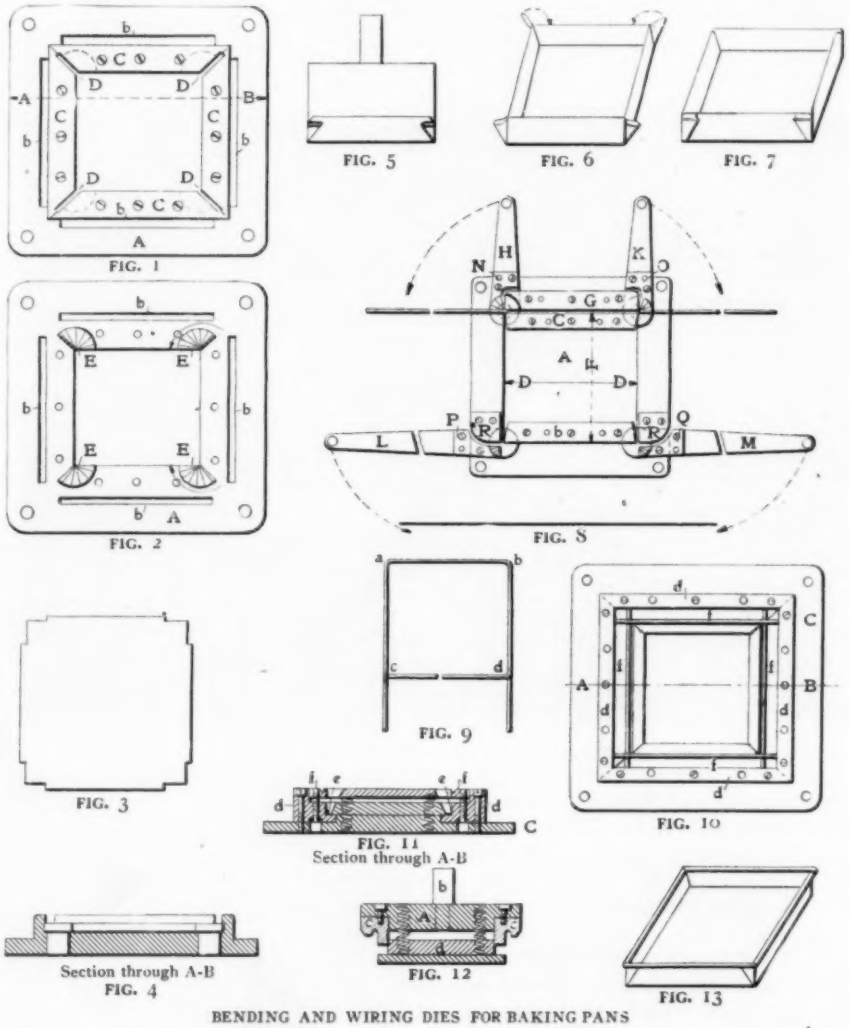
There is being introduced on the Canadian market a new flooring material called "Doloment." It has a semi-elastic lower layer which seems to prevent the objections of cracking, bulging or blistering. Its cost is from 20 to 30 cents per square foot.

Dies for Making Square Pans

By Julius F. A. Vogt

The sketches show a die for forming square pans, with the corners folded over, as is generally done on baking pans. The pans for which these dies were made, were 9 inches square by 1¼ inches deep, with the top edges wired.

It is a rather a peculiar job to form a pan all four sides up at right angles, and turn the corners at right angles close to the sides of the pan in an operation. That is to shove the flat blank through the die and have the finished pan drop out at the bottom, ready to be wired.



BENDING AND WIRING DIES FOR BAKING PANS

Fig. 1 shows a plan of the forming die. This is properly speaking a double die, consisting of the cast-iron lower die *A* as shown in Fig. 2, and the assembled double die as shown in plan in Fig. 1.

A is a casting, with four ribs *B B B B*. The bottom of this casting is planed, the four ribs being about ¾ inch high, and planed to the size of the blank. The upper die consists of four pieces of steel ½ inch thick, and in width equal to the depth of the pan. These four pieces of steel *C C C C* are mitered at the corners and

fitted into the ribs *b*. They are drilled and fastened to the die bed *A*, as shown in Fig. 1. The hole in die bed *A* is then shaped out to the size of the pan and finished.

Making the Forming Die

The corners of the steel pieces *C* are then slotted about 3/32 inch wide taking the same amount of stock from each side of the miters. The top edge of the steel pieces is then rounded over, especially the points *D D D D* at the corners. The four steel pieces *C* are then removed, and the corners *E E E E* in the lower die are finished as shown in Fig. 2. Fig. 4 shows a section through *A—B* of Fig. 1. Fig. 5 shows the punch with a formed pan sticking to it. The punch is made of cast iron, with the working part steel lined.

The working part of the punch must be at least ¾ inch higher than the hight of the lower die and the hight of the pan combined, so that the top edge of the pan when pushed through the die, will go beyond the bottom edge of the die, so as to be stripped from the punch, when the punch is going up.

The press must have a long stroke for this class of work; in this case a reducing press with a 6-inch stroke was used. The blank for the pan was cut with a blanking die, and is shown in Fig. 3.

Operating the Forming Die

The blank is placed in the gages *b b b b*, (the bur of the blank down on the die), the punch descends and pushes the blank through the upper die, thus forming the four sides up at right angles. The corners flap together at an angle of 45 degrees, passing through the corner slots *d d d d* of the upper die.

If we should stop the press at this point, and take the partly formed pan out of the die, we would have an article looking like Fig. 6 with the corners standing out. But we let the die finish its work, and the punch in going further down, carries the pan in to the lower die. The corners of the pan are then turned at *E* Fig. 2 as indicated by the arrow, and the punch forces the finished pan through the rest of the die. Fig. 7 shows a pan as formed with the die, in one operation.

Wiring the Top Edge of the Pan

The wire which was put into the top edge of the pan is No. 12 gage and cut from straight stock, and it is then formed into square rings to fit the pan. It is necessary to have the wire rings square and with sharp corners, and to secure rings of uniform size. The wire-bending tool shown in Fig. 8 was made for the purpose.

The bed plate *A* Fig. 8 is a cast-iron plate about 14 inches square planed on top and bottom. Two pieces of tool steel *B* and *C*, about 1x1½ inches and in length equal to the length of the pan, are fastened to the plate as shown in sketch, distances *D* and *F* to conform with the length of the pan. Another piece of steel *G* is fastened to plate *A* parallel with *C* and allowing space enough for the wire between them.

Four pivot holes are drilled in plate *A* for the levers *H K* and *L M* to swing in, the corners where the wire is bent over, being the centers of the pivot holes. The levers are made of flat iron tapered off toward the handles, and the ends rounded. In the widest end of the levers a ⅝-inch hole was drilled and countersunk from the top. Into this hole the pivot pin was riveted. The levers are then provided with suitable handles.

Pieces *C* and *B* are then planed off on the bottom, as shown by the dotted line, so that when the lever pivots are put into the holes, and *C G* and *B* fastened to the plate *A*, the levers can swing freely.

The four steel pieces *N O P Q* are then made, and attached to the levers as shown in sketch. They must be of the same hight as the pieces *G C B*. The two pieces *R R* are pieces of tool steel, fastened to bed plate *A*, are relieved for the levers to go under, and are tapered off toward the outside so that the wire when swung around will not strike against it.

Operating the Wire-bender

The sketch Fig. 8, shows the tool with *A* in the position to be bent. The operator pulls the levers *H* and *K* in the direction of the arrows. The forming parts *N O* on the levers *H K* bend the wire around the corners at right angles, making the two sharp rectangular bends as shown at *A—b* Fig. 9. The two bends *c—d*, are formed by swinging the levers *L M* in the direction of the arrows. This finishes the wire ring.

Fig. 10 shows a plan of the wiring die, and Fig. 11 a section of the die through *A B*. The die bed *C* is a cast-iron plate with a square boss in the center. The top and bottom of this plate are planed and the boss is squared off 1 inch smaller than the size of the die is to be.

The four pieces *d* which form the die proper, are planed in one piece, to the required shape, cut apart, and mitered at the corners. This was found necessary in order to make the small round corners, as shown at *c c* Fig. 11, to prevent the pans from buckling when being wired. The pieces *d* were then fastened to the die bed. The square steel ring *f* was then made so that the inside of it would fit the pan nicely and the outside would slide freely up and down in *d d d d*. A groove for the wire was cut around the inner top edge of the ring.

The Punch and its Work

The punch Fig. 12 was then made, the punch consisting of a cast-iron plate *A* which was faced and bored for the shank hole. The punch shank is of machine steel and riveted into *A*, after which the shank is turned to size. The four steel pieces *C* were then planed in one piece, and cut to the length. The punch plate was then milled square to proper size, and the steel pieces put onto it by means of screws. The cast-iron leader *D* was made a sliding fit in the punch. Four screws not shown, were let through the punch into the leader, the heads being counterbored in the back of the punch to give the leader sufficient travel.

The die is used in a wiring press with sliding table. The pan is set into the die and the wire ring placed around the pan into the groove of the square ring. The punch comes down and curls the tin around the wire. There was, however, one little trouble. On that side of the pan where the ends of the wire ring met, we had to put a catch to hold the wire in the groove. The catch was pulled back by a wedge-shaped piece fastened to the punch as soon as the face of the punch came in contact with the square ring. Then it worked satisfactorily.

Railroad Electrification

A representative of one of the great electrical manufacturing companies is quoted by the *Wall Street Journal* as follows: "The question is often asked: 'Why are the railroads not more aggressive in respect to the electrification of their terminals and suburban lines?' The principal reason is that the capacity of the electric plants is not large enough for the railroads to generally adopt electricity as a motive power. It is generally known that the electric companies are taxed as it is to the utmost of their respective capacities, and could not contract to electrify even a small percentage of the country's railroad mileage without being forced to shut off regular sources of consumption to a large extent. This, naturally, would result in disturbing regular channels of business. There will come a time when the railroads will be clamoring for electrical equipment, but before they can be satisfied the capacity of the electric plants of the country will have to show even larger gains than records over the last several years. Suppose that the Pennsylvania Railroad should draw up plans for the electrification of its terminals and suburban lines. The amount of work involved would represent the entire capacity of any one of our three great electric plants for perhaps a year. Many railroads have the question of electrification under consideration, and they are watching the experiments of the Vanderbilt lines very closely. There is every indication of the practical success of electric motive power on these lines, which will mark the beginning of a new era in electricity."

June exports of iron ore from the Great Lakes territory reached the record tonnage of 6,433,369 tons despite interruption of shipments by strikes in July.

American Machinery Defended

By L. G. Benjamin

Recent articles entitled "American Machinery Condemned" present a subject, which, in justice to the American manufacturer, deserves further comment. I infer that the foregoing articles referred principally to machine tools and as my experience has been wholly with this class I confine my remarks within its limits.

While on rare occasions a machine has come under my notice which, on account of poor workmanship, deserves severe criticism, it is a gross injustice to condemn all American machinery to the same class, or claim that our machinery is below generally recognized standards, because of it, for we find much evidence to the contrary. Isolated cases are surely unreliable for forming a just opinion of any general class.

It is only the machine which is subject to criticism that we hear from, consequently its faults receive prominence, while the redeeming features of its wholly satisfactory counterparts, from which there is no complaint, are ignored. Had the machine criticized been first-class throughout no credit would have been given. The purchaser seldom thinks of giving, on his own account, a report for publication if the machine fully answers his requirements, therefore it is only unfavorable comment which is made public.

Certainly in every such instance the criticism is wholly deserved, so far as the individual manufacturer is concerned, but it should stop there and not be applied to any stated class unless it can be conclusively shown that the fault is general with the manufacturers which comprise it. I believe that the American manufacturer is, as a rule, cautious about the quality of the workmanship of his product, for he realizes that it is only through true merit that he can finally hope to win. During my shop association I know of but one instance of a machine being shipped which would not have passed a customary rigid inspection, and that was on account of extreme impatience of the purchaser who wanted the earliest possible delivery. He had first been notified precisely as to its condition and with this knowledge ordered it shipped.

It Taught a Lesson

Within a few months he entered a kick which has since resulted in the return of the machine. Although in this case the user was partly to blame, the manufacturers showed poor policy in allowing it to pass. However, the experience was a good one for it resulted in the adoption of a policy to never send out any machine which the management itself would not consider good enough for its own use.

There are existing conditions, which to our mind present strong evidence of the superiority of the American machine tool. It is seldom that we find foreign tools in American shops, yet we do know that American tools go all over the world, and this in spite of the fact that in their own country the advantages of competition (outside of the quality of the product) is all with our competitors. Our patent-office is open to the inventors of all countries and his patent will hold good whether he manufacture the patented article here or not. In all foreign countries the patent is not valid unless a factory is established for its manufacture in that country.

As a consequence the majority of American tools are not protected by foreign patents. The added expense of high duties, excessive transportation charges, the maintenance of foreign offices, make our successful foreign trade still more difficult. To my mind, the superiority of the American tool is convincingly evident, for with an inferior or only equally efficient product, successful competition under such great odds would not be possible.

Economic Manufacturing

There is reason to believe that the American manufacturer has come nearest the solution of the problem of the best economic manufacturing, especially in machine tools. The term economic is used in its broader sense, comprising superiority, durability and general all around excellence in both design and workmanship, for in the long run these traits are necessarily consistent with the best economy. The makers of American products have taken the initiative in compiling and devising various systems each best adapted for some particular line of manufacture, which were the natural sequence of our policy of specialism. These systems have so changed the old regime for the betterment and profit of the business, that their excellence is not disputed.

Some of our English cousins infer that we have been too aggressive in our efforts for economical production, that through our different systems we have tended to sacrifice quality in trying to reduce cost. Experience has shown us that the contrary is true, that the system itself gives us more accurate results, more reliable workmanship and perfect interchangeability. It also keeps accurate record of all materials, shows their results in use and enables us to select the material best suited for the purpose for which we intend it. According to authentic report, many representatives of foreign manufacturers have visited America for the sole purpose of making a study of our shop systems. Many of these systems have been adopted abroad, sometimes in their entirety, where progressive manufacturing is done.

Finish Versus Accuracy

Conceptions of the standard quality of machine tools vary. An incident which came to my notice recently well illustrates this difference of opinion. We had just set up a new milling machine of reputable make and a visitor from a neighboring shop was looking it over. While commenting on its several convenient features the tool-room foreman remarked that it did not have the "get up" that some of his other machines had. For comparison, he pointed to a machine near-by, whose guides were neatly spotted in small evenly-spaced diamonds, the castings were filled with such care that each surface was exceptionally straight and were painted in a hard, glistening egg-shell finish. The polished parts were as a mirror. Inquiry, however, brought out that the machine was not entirely accurate, that in use it was necessary to make certain allowances for error, also for some classes of work it was inconvenient and required much time for setting up. Heavy work was never done on it as it was not sufficiently rigid.

The new tool was convenient, for with its accompanying attachments it was quickly adaptable for all of our tool-room work. A test showed it to be accurate and with sufficient stability. Our visitor's remark—"What more do you want"—accompanied by a suggestive shrug of the shoulders, was an expressive termination of the discussion.

Some time ago we received a planer which in appearance, so far as finish goes, seemed crude. There was hardly a round corner on the bed; every edge was finished with a straight bevel. The casting was not filled but finished with only several coats of paint. In use the machine certainly made good, for it receives a better class of work than any of its finer-finished brothers. There is no tool in the shop more highly prized.

The average American manager insists upon a neat, clean appearance of the product, but high finish and superficial touching up he deprecates if it does not enhance the utility of the tool. When guides are scraped to a good bearing, it is deemed sufficient, ornamental scraping being considered a waste of time. The user must invariably bear the expense of this extra work, and for that reason American tool buyers sometimes object to it.

Aim of the Practical Designer

The practical American designer's sole purpose is to produce a machine which will perform its intended functions more quickly and accurately and with greater economy, than those with which it is to compete. Precedent in design and general contour is often wholly ignored and an entirely new departure is made from the conventional shape of a certain class of tool, if by such change the result sought for is attained.

Comparing the evolution of machine tools made in America with those of European countries, it is evident that the American has been more radical in this

respect. He has not hesitated to discard the conventional regardless of the criticism which he at first encounters. One of the best opinions which I have ever heard, regarding the appearance of machinery, was given by a designer whose long practical experience with many classes of work gave his opinion weight.

What Looks Right

The occasion of his statement was a comment on the odd appearance of a casting for a machine which he had designed. It was, "No matter what the shape or contour of a piece, if it answers the purpose intended for it, as no other will, it looks right. Architectural design and machine design have little in common. One is designed first for symmetrical outline and pleasing appearance, the strength of the structure with its factors of safety being the second consideration; the other is planned primarily for efficient, accurate and economical operation and its appearance is of little consequence so long as it is not unnecessarily awkward, bulky, or ill proportioned for the work which it has to do."

To illustrate the point of view of him who hesitates to break precedent and the fallacy of his position, he related an incident of his career. Some years ago he had been connected with an agricultural-implement concern. They had been making a grain separator which for many years had been little changed in outline. He was requested to remodel it and did so, so radically that its appearance was greatly altered, a fact which seemed to annoy the secretary of the company. One day after a very successful test of the experimental machine, the secretary remarked, "Frank, it seems to work all right, but confound it, it doesn't look like a threshing machine." Our friend's reply, "Alec, will you tell me just what a threshing machine looks like?" was conclusive. At the time it was a radical change, yet the conventional shape of grain separators today is very like that experimental machine.

Changes and Improvements

The modern American shop is constantly improving and changing its product, always on the lookout for something better, and its equipment is so chosen that it can handle these changes at short notice. Probably foreign shops are well equipped for the same purpose although in some instances I am sure that they are not. We do know that a particular type of machine tool remains standard with them for a greater length of time than is usual in America. To illustrate, several years ago a German tool company began the manufacture of a grinding machine which was almost an exact copy of a well known American make. Today they are building a machine several years behind the times and the American successfully competes with them in their own territory.

Some of our foreign brothers will take exception to some of the opinions herein expressed, and we assure them that any light on the subject from their point of view will be appreciated. Incorrect opinion is often the result of a misconception of the actual conditions affecting the subject. Prejudice is also a factor to be considered. If I am in error, will welcome convincing evidence adverse to the foregoing sentiment. The machine-tool men of America realize that there is much to learn, for the constant appearance of newly improved product is due to that realization. There may be reasons for belief that American tools are not up to the European standard, but evidence, so far at hand, tends to convince us that the contrary is true. Poor workmanship should be condemned no matter where it exists. If that of the American tool is below the recognized European standard, I am confident that no one will welcome criticism more quickly than the aggressive American manufacturer, nor be so ready to remedy the fault, if it exists. However, the one fact alone, that our competitive policies in other countries have been so remarkably successful, seems to discredit the criticism as unjust.

Standard Proportions for Machine Screws

By A. H. Bartlett

The articles on pages 126 and 156 under the title which I have used should be carefully considered by shop men who are truly interested in the mechanical advance of our great country. They present the results of some four or five years' deliberation by a committee of very able men. The report upon which they are based has been accepted by the American Society of Mechanical Engineers. Yet there seems to be a disposition to ask, when discussing this standard, "Would not such and such a line of procedure have given good results?" For illustration see the letter of Godfrey, on page 235.

My habit of mind is one of respect for standards in general, and this leads me to appreciate that there must be a great deal of difficulty in establishing a new one. A viewpoint from which one can look in diametrically opposite directions is needed. The past with its records is a reality on one hand, while on the other are the advantages of a wise decision extending to no one knows how great a period of time and breadth of activity. A determination must be made as to which, past or future, shall predominate in establishing the new standard. I am assuming a certain amount of antagonism between the past and the future, for this usually exists. The past is chaotic; the future, with an accepted standard, should be orderly.

It was my privilege several years ago to weigh the influences of past realities and future advantages in connection with the standardization of the proportions of screw-machine work—mainly machine screws—in a large factory.

A line of some two hundred machines was manufactured on a basis of interchangeability of parts. Some machines had been made for 40 years. Of some types thousands had been put on the market. Many different kinds of screw threads, body sizes, head sizes, shapes, slots, etc., were in use. A very far-sighted management decided that in determining the new standard the advantages of the future outweighed the history of the past. Five years of use have showed the wisdom of this decision.

That the viewpoint of the American Society's committee was toward the past is clearly shown by the results and is stated by this sentence in the final report, "and avoids an impracticable degree of departure from the already established screw gage diameters"; and again, "because the resulting pitch diameters are more nearly in accord with the pitch diameters of machine screws in present use." A certain amount of departure is admitted; why could there not have been more? How far reaching would have been the influence of the past after the present stocks of screws and taps were exhausted?

My standpoint is that of a machinist who has had something to do with screw-machine work, its standard proportions and its use. There are 21 sizes of screws in the new standard, ranging in body diameters from 0.060 inch to 0.450 inch. Here is a new wire gage standard. In my note-book I already have six, and those are not all. What is the advantage of a screw 0.060 inch in diameter over one 0.0625 inch in diameter? We know what to call the latter, but what is the apparent name or number of the former? Why is not a 1/16-inch screw serviceable? Similarly 0.190 inch is pretty close to 3/16 inch, 0.242 inch is not far from ¼ inch, 0.372 inch is only 0.003 from ⅜ inch, and 7/16 inch is about halfway betwen 0.424 inch and 0.450 inch. Would not the nominal diameters, good old-fashioned fractions of an English inch, serve as well as the dimensions in thousandths which we have mentioned? Every apprentice boy has a concrete idea of how large a sixteenth or an eighth or a fourth of an inch is. Good machinists can be found to whom 0.424 inch is a hazy quantity until they look up some nominal size near it on their micrometer.

Again the successive difference between body diameters from 0.006 inch to 0.242 inch is 0.013 inch. How is this difference better than 1/64 inch? The superior limit mentioned is 0.242 inch or about ¼ inch. From this point on why are not 1/32-inch

differences serviceable? I have used a great many 9/32 and 11/32 screws. Or in another way, why could not the screw body diameters have been fewer and made to mean something? Mr. Godfrey suggests this in his article when he says, in substance, "Why not have a No. 16 screw measure 0.160 inch in diameter? It seems as if the sizes 0.060, 0.125, 0.190, 0.372 and 0.442 are so close to fractional sizes that the fraction sizes might have prevailed. (Of course, 0.125 inch is 1/8 inch.)

The number of threads per inch for the various sizes is diversified. When the thread in a tapped hole has been partly stripped, how pleasant it is to be able to retap it a size larger and to the same number of threads per inch and put in a new screw. Are so many different threads necessary?

Glancing at the head diameters for the fillister-head screws, it is seen that another wire gage standard is with us; while the body diameter dimensions are

B From Report	*X* Nearest Fractional Size.	*Y* Decimal Equivalent	Difference *B* and *Y*.
0.0894	3/64	0.093	0.0036—
0.1107	7/64	0.109	0.0017
0.132	1/8	0.125	0.007
0.153	5/32	0.156	0.003 —
0.1747	11/64	0.171	0.0037
0.196	13/64	0.203	0.007 —
0.217	7/32	0.218	0.001 —
0.2386	15/64	0.234	0.0046
0.2599	17/64	0.265	0.0051—
0.2813	9/32	0.281	0.0003
0.3026	19/64	0.296	0.0066
0.3452	11/32	0.343	0.0022
0.3879	25/64	0.390	0.0021—
0.4305	7/16	0.437	0.0065—
0.4731	15/32	0.468	0.0051
0.5158	33/64	0.515	0.0008
0.5584	9/16	0.562	0.0036—
0.601	19/32	0.593	0.008
0.6437	41/64	0.640	0.0037
0.6863	11/16	0.687	0.0007—
0.727	47/64	0.734	0.007 —

TABLE 1. FILLISTER-HEAD SCREW-HEAD DIAMETERS COMPARED WITH FRACTIONAL DIMENSIONS.

in no case carried beyond thousandths, these head diameters in 15 of the 21 sizes are carried to ten-thousandths. In general I did not consider that the head diameter was as important as the body diameter. My practice has been to make a counterbored hole for the head of a fillister-head screw 1/64 inch larger in diameter than the diameter of the head. By adding 1/64 inch to the dimensions for the head diameter, I see we shall have a new standard for counterbores, although some sizes fall serviceably close to present standards.

Table 1 shows us that these head diameters vary from common fractional sizes by slight differences ranging from 0.003 inch to 0.0008 inch. Would not fractional dimensions carried to three places of decimals have served?

The column headed *C* gives the length of the head for the flat fillister and the length of the head to the start of the oval for the oval fillister. Here 18 out of 21 dimensions are expressed to ten-thousandths of an inch in one case, and 20 out of 21 in the other. This dimension my practice has always considered commercially exact, if accurately measured with a scale. Are such refined measurements necessary?

In column *D* are given widths for the slots in the screw heads. There are 21 sizes of screws listed, and 21 widths of slots. Does this imply 21 widths of screwdrivers? What is the advantage for a given size of screw head of a slot 0.039 inch wide over one 0.041 inch wide, or *vice versa?* Are 21 different widths of slots necessary for 21 diameters of heads, the smallest 0.0894 inch in diameter, and the largest 0.727 inch in diameter? The range of head diameter is 0.6376 inch.

The Brown & Sharpe Manufacturing Company, in their catalog, list 14 thicknesses of screw-slotting saws for the range from 0.125 inch to 0.825 inch or 0.750 inch. Here are two-thirds as many cutters and a wider range. Both the Pratt & Whitney Company and the Brown & Sharpe Manufacturing Company list their screw-slotting cutters to the American standard wire gage for thickness. Three of the slot widths under *D* correspond with cutter thickness, according to the standard mentioned. So having those three we have a new standard for thin screw-slotting cutters. Is this necessary?

A few sentences back I asked a question in regard to the relative advantage of a slot 0.002 wider or narrower in a given screw head. One point occurs to me. If the standard called for a slot 0.041 inch, and the operator failed to have a suitable cutter, he might take one a size thinner, or 0.039, and cause it to run out enough to give him the 0.041 slot. By careful "wabbling" a skilful operator might keep down the number of thicknesses of cutters necessary to carry in stock, as the variation of thickness is so slight in many cases.

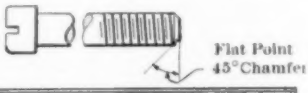
The column headed *E* in the tables gives the depth of the screw slot. In every case this dimension is expressed in thousandths of an inch. There is a different depth for each one of the 21 sizes of screws listed. Heretofore I have always used a scale measurement for the depth of the slot. Now I should judge a depth gage would be necessary. However, a flat fillister-head screw has a head 0.2813 inch in diameter, or say 9/32 inch. The table calls for a slot depth of 0.057 inch. Would not a depth of 1/16 inch have been as serviceable? Other cases similar in character might be cited.

And still the standard has been recommended, and if generally accepted will do away with much of the present confusion. Yet is the new standard reduced to lowest terms? Is it in the most serviceable form which it is possible to get?

In the earlier part of this article I referred to some standardization work with which I was connected. It may be of interest to show how that work was done, although it does not parallel the work we have been considering. It covered the range of screw-machine products: screws, nuts, washers, studs, pins, etc. A set of standard tables was prepared for each kind of the machine parts standardized. Table 2 shows the character of these uniform dimensions. It was made out for round-head cap screws.

No attempt was made to write formulas. All dimensions are expressed in simple fractions, or fractions and integers of the English inch as far as possible. The one exception is in the width of the slot in the screw, which is expressed in thousandths corresponding with the thickness of slitting saws made to the American standard wire gage.

It will be noticed under the heading "Radius of Corner" that only three radii are listed for the entire schedule of 12



Diam. of Screw	Diam. of Head	Length of Head	Radius of Corner	Size of Slot No. of Saw	Size of Slot Decimal	Depth of Slot.
1/4	7/16	1/4	3/32	#19	0.035	1/16
5/16	9/16	5/16	1/32	#16	0.051	1/16
3/8	5/8	3/8	1/32	#16	0.051	3/32
7/16	3/4	7/16	1/16	#14	0.064	3/32
1/2	13/16	1/2	1/16	#14	0.064	1/8
9/16	7/8	9/16	1/16	#12	0.081	1/8
5/8	1	5/8	1/16	#12	0.081	5/32
11/16	1 1/16	11/16	1/16	#10	0.102	5/32
3/4	1 1/8	3/4	1/16	#10	0.102	5/32
7/8	1 5/16	7/8	1/16	#8	0.128	5/32
1	1 1/2	1	3/32	#8	0.128	5/32

TABLE 2. STANDARD GENERAL DIMENSIONS OF ROUND-HEAD CAP SCREWS.

screws. Under the heading "Size of Slot" only six widths are called for. Under the heading "Depth of Slot" only four depths are called for. It was the aim to prepare a serviceable standard and yet keep it as simple as possible.

This same general system was followed for establishing a standard for the other kinds of screws in use. All styles of head had a flat surface, and the rounded corner. All points were flat with a 45-degree chamfer and so on. The flat end and rounded corner were also applied to studs, pins, washers and shafts. In this way a very few circular cutters covered the entire range of ends for all kinds of screw-machine products. As I have stated, these standards have been in use for five years. There has been a great economy brought about by their use. Larger manufacturing orders have been possible, and the product is uniform. All new machines have their screw-machine made parts selected from stock as far as possible. In some cases this is as much as 95 per cent.

Hardness Standard for Hardened and Tempered Work

By James Steele

The article on page 845, in regard to a hardness standard, is amusing to a tool hardener or to anyone who knows the mystery spoken of by Mr. Pratt. He states that there is no place in the machine shop where a standard is needed as badly as in the hardening room, and that the hardening room has nothing. This I consider an acknowledgment on Mr. Pratt's part that he is not posted in the hardening of tool steel. We have first a given heat for every make of steel, and second a given heat for every grade of that make. This heat we term the standard. Where the pyrometer is not used there could be a small variation in the heat which Mr. Pratt has acknowledged was not more than from 5 to 10 degrees in the case he investigated. This is not worthy of consideration.

As long as we do not know just what the piece was that his hardener was handling, possibly he wanted just what the pyrometer registered; but when the steelmaker tells us that his steel will vary in carbon from 10 to 15 points, then it still makes the matter of 5 to 10 degrees of practically no consideration. Again there is not a furnace in existence that will not allow of variation in the temperature of the heating chamber. In fact, I do not know of a furnace in use today in which there is not more variation than from 5 to 10 degrees. Thus after considering these points we can see that the hardener has a standard heat.

The next thing we have to consider is the plunging bath. It is useless to discuss this point as we all know that we can have the bath just as we want it at all times; thus there is no trouble in getting a standard bath. There could be a button placed in each end of the bath so the hardener could register each motion and the exact speed. Thus we could force each tool through the bath at the same rate of speed, but I hardly think Mr. Pratt would want this. As the heating and plunging are standardized, it is now only necessary to prove that we can temper all pieces just alike and to a standard. In the first place, Mr. Pratt has given us but 10 different tempers when in fact we have 18 distinct and different tempers by color, in one grade of any make of steel. I will say there is hardly a hardening room that does not utilize the entire 18 in one day's work. The only thing that interrupts this standard, is when the steel that is to be machined is of a different degree of hardness. Thanks to Mr. Ballentine for his testing machine which will tell us the degree of hardness! This will save the tools and help to preserve the standard which has been proved true beyond question, and which has been in use for years.

By oil tempering with a thermometer, the tempering at once becomes uniform and alike on all pieces.

I am in charge of a machine shop and hardening room where tools are produced for other departments and when the tools do not give satisfaction it is my privilege to look into the trouble. Having had several years at the tool-hardening business, I am somewhat acquainted with the complaints that come to the hardening room. I also know of the unreasonableness of some of them. I know the impatience of the hardener when he gets complaints from some tool inspected under the standard adopted by Mr. Pratt. I have taken tools that have become standard in our shop, hardened them at a heat which would produce the best possible grain, cooled them in a bath that was positive, tempered them with the use of the thermometer and sent them to the department that was to use them. The inspector and foreman would get a file and commence to scratch, pry and twist and presently we would get the entire lot back to be drawn a little more. In such cases I would have the tools set to one side and wait until there was an inquiry made for them. During the interval I would give them a coating of oil so that they would have the appearance of having been in the oil tempering fire. In such cases as well as all others I noted the results very carefully, and in 99 cases out of 100 we would get word that the tools were doing well. So in this way we get standard data for our hardening room.

I at one time had some end mills returned. These tools were heated in the lead bath on the cutting edge only. The hardener had them in the bath and stopped to do another piece of work. During the interval the shanks were colored by the heat. The shanks not having been ground before coming to the hardening room, it was found that it would be necessary to change the shank. They were returned to me with the word that they could not turn them. As I saw the work hardened I knew that they were as soft as they had ever been; so I took the pieces and rubbed them with sand and returned them to the machinist. He reported to me that they worked fine. Again we strengthened our standard that we use in the hardening room.

Before passing this point I wish to say that I have the highest regard for the men who returned this work. So much so in fact that I never mention to them the way in which I handle their jobs. As long as they think that their requests are carried out they feel that they have helped me as well as themselves. Instead of giving them the corner that Mr. Pratt gives to the hardener who tries to throw an air of mystery over his work, and has made Mr. Pratt believe that he believes in his powder or compound, we give them credit of being able to test tools by the use of a file. It is the file in the hands of our best men that convince me of the folly of such a standard test as prepared by Mr. Pratt.

After years of experience and with results as stated, I have come to the conclusion that such a test is not only worthless but misleading. The proper way to test steel is first to consider what the steel is intended for. Is it for high-speed or medium work, for roughing or finishing or for chilled rolls? It would be unreasonable to test steel intended to cut chilled rolls with carbon steel, and again it would be unreasonable to test carbon steel with high speed on a roughing cut. Consequently, after considering what the steel is to be used for, then it is "up to" the hardener to give you the best possible grain in that steel. After this is found then the tools should all be hardened and drawn until they lose their temper, noting that point for each piece. Then make three tools of each kind of steel, giving each one a different temperature in drawing or with a variation of say 10 degrees between each of the three tools. This will enable you to get the best results and give you a standard to temper by at once. With a testing tool such as Mr. Ballentine speaks of on page 698, you may select your tool from actual data, and not from the keenness of the file nor the strength of the inspector. The one that gets soft first will be your tool for slow speed and smooth cuts, while the one that is the hardest to draw will stand the greatest speed. There should be a test as to the relative size and degree of hardness of the cut that the two pieces first losing their hardness will stand. If a chilled roll is not convenient, take a piece of common tool steel, harden and draw until it can be cut and use this to test the steel. This will give you better results than any other test I have ever witnessed.

While this will test the steel in working, etc., it will not tell you what the comparative loss will be in the hardening. Of course, this depends somewhat on the appliances for hardening and the hardener. Some steels will carry a greater per cent. of loss than others, and this should always be considered. After this has been thoroughly tested, and you have obtained your tempers, do not let anyone convince you with a file that the work is not what it should be. Make the test of the tools in use and in no other way.

The best way to repair the faces of vises is to dovetail new faces on, and pin them in place, taking care that the pins can be driven out when the faces require re-roughing.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

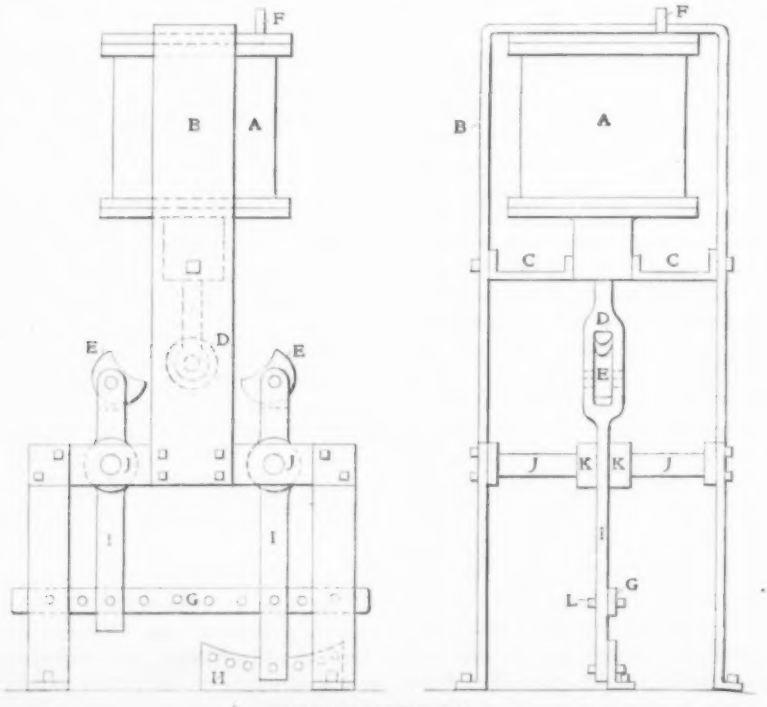
A Pipe-bending Rig

The sketch shows a pipe-bending rig which is easily constructed. No castings are required, except the cylinder. The one shown is an air-brake cylinder such as is used in railroad work.

The cylinder *A* is supported by the housing *B*. *C C* are braces to give rigidity. Air is admitted to the top of the cylinder, causing the piston to descend, bending the pipe, which is placed between the roller *D* and the shoes *E E*. A spring in the lower end of the cylinder raises the piston when the air is released. The air valve is conveniently located at *F*.

Adjustment for different-sized arcs is obtained by means of the link *G* and the quadrant *H*, which is fastened to the floor. The link is suspended on the arms *I*, which move freely on shafts or rods *J*. The collars *K K* keep the arms in alinement with the piston and are held stationary by means of set-screws. Different shoes and rollers are used for the different sizes of pipe. The link *G* is a piece of flat iron bent U shape, with holes drilled for the pin *L*. A similar pin is used through the arm and quadrant. With 80 pounds of air an 8-inch cylinder will bend 1¼-inch pipe to a 12-inch radius, cold.

W. T. HARRIS.



A PIPE-BENDING RIG

Making Low-priced Impression Dies for Hard Rubber

We recently decided to manufacture a certain hard-rubber article which on account of competition had to be produced in thousands and very cheaply. This article took quite a complicated sectional mold to form it. Our greatest difficulty was to make a fancy impression die that would stand up against the heat, wear and chemical action of the hard rubber. The first die we had sunk in tool steel by a die sinker and this gave every satisfaction. It was durable and withstood heat and the chemical action perfectly—but it cost $20 and could not be made for less, and as we needed several thousand of these it was impracticable to consider using hand-sunk tool steel dies.

Our first attempt at reducing costs was to cast soft metal dies of various compositions but although we got exceedingly sharp and accurate castings, with metals which withstood the heat and chemical action to perfection, yet they all were a failure when it came to durability—half a dozen sharp clear impressions were generally all we could get. As it was impracticable to change dies every sixth impression we had to scheme out something more durable. After considerable experimenting, we found an alloy of aluminum that was fairly good, not anywhere near as durable as steel but still greatly superior to the soft-metal alloys, and right here we struck trouble in every form. We could not get sharp castings, we could not get uniform castings and we could not get anywhere near the accuracy desired (0.002-inch limit). We tried steel molds, plaster of paris molds and all kinds of molds, next we tried chilling the molds, casting under pressure and in fact everything we could think of but still the results were poor according to our standard. Finally we had to abandon the idea of casting and try pressing the design into aluminum blanks. This method, however, proved far too costly and we could not get the accuracy and finish desired.

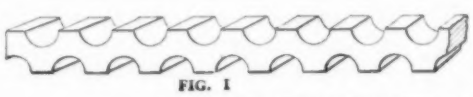


FIG. 1

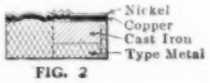


FIG. 2

LOW-PRICED IMPRESSION DIES FOR HARD RUBBER

It was next proposed that electrotypes be used. In a few days the sample electrotype was received and although it was not all we could have wished for, still it was very creditable for the first one. Soon we had a mold fitted up and put in the vulcanizer and could hardly wait until it came out; when it did, the hard rubber was the greatest freak you ever saw. Of course we ought to have known better than to expect the sulphur in hard rubber compounds not to combine with the copper under the influence of 320 ° F. They did combine and the electrotpye had become more like a fine honeycomb than a die. However, this did not discourage us and our next experiment was an electrotype with a thin film of nickel over the surface of the copper, this gave greatly superior results but not entirely satisfactory because a slight film of nickel would persist in adhering to parts of the hard rubber. After considerable experimenting we finally discovered a parting compound that completely cured this and success was well in view when a new trouble appeared. The 0.001-inch of nickel was not thick enough to thoroughly protect the copper from wear, and as we thickened the nickel shell we lost in sharp-

ness of the design. There was only one satisfactory way out of this and that was to deposit the nickel right on the wax first and back it with the copper shell. This was easier said than done, and we tailed to find a firm of electrotypers who could deposit 0.01-inch of nickel on a wax-impression and back it with copper—the nickel would persist in peeling off long before the 0.01-inch thickness was reached. So I started in to experiment with nickel baths and in about two months had a bath that would give a nickel deposit of suitable thickness without any tendency to peel. A small electrotyping plant was established and we started in to manufacture dies in quantities. However, our troubles were not all over, as we discovered when the electrotype backing slowly and surely squeezed out of shape and gave inaccurate results about the twentieth impression. To cure this cast-iron reinforcements were made, see Fig. 1. These were held on the nickel copper shell in the casting jig, the type metal being cast all around and our troubles were completely overcome. We now make sharp, accurate, durable dies having wearing qualities almost equal to tool steel at a cost of $1 each, thus making a process practicable that would not have been so if the dies had been more costly. A sectional view of the finished die is shown in Fig. 2.

GEO. P. PEARCE.

Pennsylvania.

Making Press Dies

In the AMERICAN MACHINIST at page 680 there was published an article entitled "Washer Dies and How to Make Them," by Pressman. It seems to me that a few suggestions thereon may not be amiss.

Pressman finds that punches wear faster than the die. If he makes them as his drawing shows, this is only to be expected. A better way for him to make his tools would be as shown by the sketches herewith.

Fig. 1 shows side elevation of die *a* and punch *b*, which is in partial section to show the construction clearly. The die itself calls for no comment except that it shows much less clearance or taper in its working parts. The upper member *b* shows a punch holder (socket, Pressman calls it) fitted with a pad by means of four taper headed screws as shown. The punches are parallel the whole of their length and are a force fit in the pad. Their upper ends are slightly upset, although if a good force fit and inserted from the back this is hardly necessary. The blanking punches are drilled through and the pilots inserted. The pilots are not hardened, simply stiffened.

The function of a pilot is to insure the blank being punched out in correct relation to the hole already punched in the stock. To do this it must have a portion near the blanking punch the full size of the hole and be parallel for a length about the same as the thickness of stock being used. A pilot as shown by Pressman is of little use, as it allows the punch to get to business too soon. Should the operator fail to locate the stock correctly, he either gets an eccentric washer or runs the risk of making a waste one and breaking off his pilot; hence he says pilots should be soft. The shape of his pilots is one cause of their breaking; being solid with the punch is another, and another one is that sometimes the piercing punch enters the stock too soon, being too long, and so prevents the pilot locating the stock correctly. A good plan is to make the piercing punches a little shorter than the ones for blanking, say about half the thickness of the stock.

Pressman says the dies cannot be ground if made level. From this I presume he has to grind his dies on the old grindstone if they get ground at all. If this is so, he should get his lathe fitted with an overhead motion, and his rest with a grinding attachment. He will be able to grind both dies and punches then by fixing them on his face plate. His swedges and peening hammers, fullering punches, etc., will then be things of the past, as he will be able to grind up a set of tools in a lot less time than he now spends heating, peening up, annealing, refitting, and rehardening; also he will have less breakages consequent on so many hardenings.

His simple expedient of making one holder do for three sizes is false economy, as a moment's thought will show. Every time he repairs his punches or changes from one size washer to another the required amount of offset or eccentricity has to be found anew, thus wasting time.

As he adopted this system to save fitting sockets, let him make his sockets and punch pads interchangeable, that is, standardize them. To do this, all he needs is a jig, as shown in Fig. 2, to drill his pads, and a reamer to ream the holes the correct taper when drilled.

Fig. 3 is an end elevation of punch and die; Fig. 4 is plan of die; Fig. 5, an inverted plan of the punch pad and punches. The jig, Fig. 2, is of gray iron of section

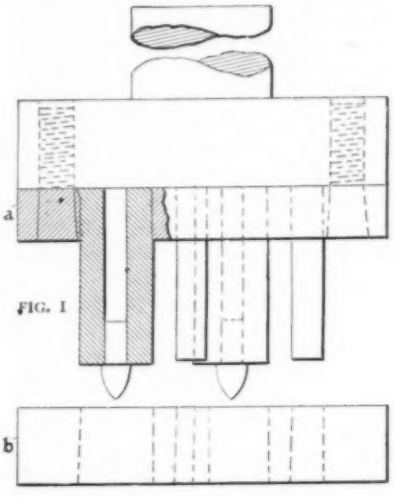


FIG. 1

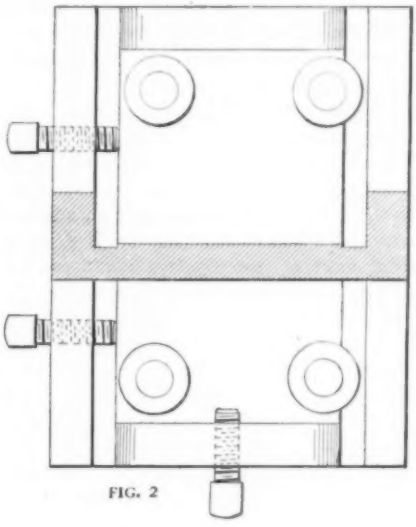


FIG. 2

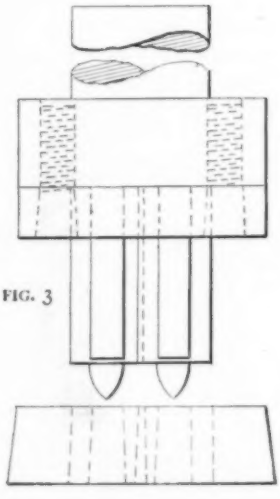


FIG. 3

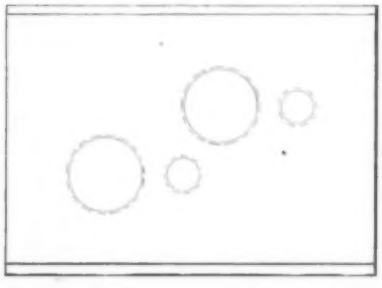


FIG. 4

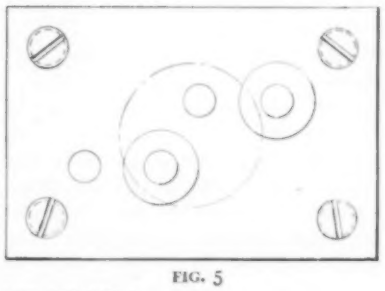


FIG. 5

MAKING PRESS DIES AND PUNCHES

shown, planed top and bottom and with hardened brushes inserted.

Incidentally I may mention that with tools made as described I have run 100,000 washers through at one setting, cutting one at a time, size 13/16 x 5/16 inch by 18 Birmingham wire gage.

WILFRID GEORGE.

England.

Who Will Do the Hard Work?

The query of W. D. Forbes on page 47 is one that is so often asked and so seldom answered that it seems deserving of attention. The question briefly put is this: If everyone is educated to do the agreeable, easy work, who will do the coarse, disagreeable, dirty work? The asking of this question shows in the first place a misconception quite as common among the educated as the uneducated of the object and use of education. When a man learns anything, a new fact or a name, say, it simply means that by dint of persistent will power he has impressed that fact on his brain. It may be that he has impressed it lightly and that the impression soon fades; or he may have impressed it heavily or over a long continued period, in which case it stays. To say that a man is educated means, then, that his head is full of impressions put there by the exercise of will power, probably by his own will power, though it is a question whether in youth, especially, the will power of the parent or teacher does not go farther than that of the child.

Education as given in the schools or by books can go no farther except in one way. What a man does with his education is beyond the power of education to direct, except in so far as it may have helped to form habits of industry in the early stages of its progress. In other words, education does not always "take" any more than vaccination does, nor nearly so often. This morning I met an example of this in a man whom I have known for years. He is educated, but from what college he graduated I do not wish to remember just now; but he did well. He can talk with you even brilliantly on almost any topic of the day. Yet I have had working for me dozens of what we call uneducated machinists at two dollars and a half a day or less who are of vastly more use to themselves and the country than he. Now, why? Simply because he has not the will power to do anything. He needs rousing out of a dream; he is lazy.

However, to men who read the AMERICAN MACHINIST this is not a common misfortune, for usually if a man has acquired any education by himself it shows that he is active enough and has the will power to use it. And to get clear around the circle, if he has the requisite will power he will get the education. So there you have it. A man who has it born in him to do the finer, agreeable, easy work, will educate himself to do it, and the man that is not born that way will not educate himself.

If the education is forced on him, or fed to him with a spoon, it does him no good, unless something happens to rouse his will power and make him use it. The things which will rouse him seem to be outside the province of an educator now. If we could take away from some of these men all their wealth and leave them naked and penniless, with nothing to lean on but themselves, then they would rouse up and be useful members of society; but since we cannot use such drastic measures, there will always be more than plenty of people to do the drudgery and the disagreeable, dirty work.

I think just now of two men, both threescore and ten and more, who each started with less than ten weeks' schooling. One is a bright old gentleman, too fastidious to soil his hands with honest toil, and one who has never been able to rise above what some of your readers would call the dirty work of police and jail service. Today he draws a salary no greater than your readers will average, for putting in time, not for work. He has had for 50 or 60 years as much time available to use in study as the college boy has, and yet he complains of his hard lot and thinks that early education is the only thing he lacks, and he thinks the community owes him a pension for long, faithful service.

The other man has made himself a name many of you would recognize. He takes no credit to himself. He says: "I was forced to do things. I lost my job and was *forced* to go into business to support my father and mother. I *had* to learn to read and write and figure to keep my accounts. I simply *had* to, because I bit off more than I could chew and then I was too proud to spit it out. I got into the real estate business because I had to keep my best customer's work. I have been the creature of circumstances all the way through life. If I had only had the education you have had, young fellow, why, I could have earned money so fast that I never would have saved any. I wish I had had it just the same." One was the creature of circumstances, the other the victim; and they would have been just the same with education as without. It is will power that gets a man out of the bread line, not education.

The tendency of the times is to do away with heavy manual labor. Our inventions of cranes and handling devices are for just that purpose; but all these inventions tend to make the line between skilled labor and unskilled labor more marked by lessening the opportunity for the unskilled. This in turn forces on the unskilled that necessity which is the very parent of will and rouses more and more of the unskilled to make their way upward and thus automatically maintain the balance of forces about which our friend is worrying.

AN EDUCATOR.

More about Internal Grinding

In reading H. N. Jackson's article on internal grinding at page 95, I was reminded of a similar case that recently came under my notice. This was an attempt to use water in grinding automobile cylinders. It was found that the water made a paste of the fine grindings, which rapidly filled the surface of the wheel and destroyed its efficiency. The use of water was abandoned and the work is now being done successfully without it.

On external grinding, the stock which is removed is thrown down and away from the wheel, and does not get into the surface of the wheel (unless the latter is too hard) in sufficient amount to interfere with its cutting action. In internal work, the grindings are thrown against the surface of the work which is being ground, and if they are wet they stick there and get into the wheel. If the work is done dry, the grindings may be removed by an exhaust fan.

H. A. RICHMOND.

Turning Rubber Rolls

The two articles about turning rubber rolls, which appeared in your paper, were quite interesting to me, for I have had to turn a number of them. As I did them in a little different way, it may also be interesting to some of your readers.

The rolls were about six feet long and sometimes two or three inches larger, five or six in diameter, and were used as feed rolls on hide and leather splitting machines. These rolls were highly perfumed from the hides and leather, and this made turning the rolls a desirable job. It appeared that I had a drag with the foreman, so I usually got the job.

These rolls had to be straight and smooth, although from the appearance of the rolls when brought to the shop, anyone would think that almost anything would do. Being very uneven and out of true, we used a tool like a bent side tool, only with a great deal keener edge. The tool being set so that the cutting edge was broadside to the roll, by running the roll quite fast and using a coarse feed, the roll was roughed down to nearly the right size. This tool left the roll very rough but quite straight and true.

We next took a board about 12x12 inches and tacked sandpaper on one side (it is best to tack the paper on the top edge and then bend it over the flat side) and wedged this tightly into the T-slot of the tool rest. By running the lathe at high speed and using a feed of from 6 to 8 turns to the inch, the roll is soon quite true. For finishing, it is advisable either to reverse the lathe and hold on, by hand, the board with the sandpaper, or swing the roll around in the lathe. This seems to give a better finish.

As Mr. Gribben states that his emery

cloth gets clogged up if he does not brush the small particles off the roll, I would advise him to rub powdered chalk or lime on his roll. This will prevent most of the splitting, at least it always does on these splitting-machine rolls. At the finish, a light touch with the sandpaper will remove all traces of the chalk or lime. These rolls were finished in from four to five hours and were quite smooth and true.

A. L. BERT.

Tapping Shallow Holes

We had to tap a blind hole in some fiber disks, or washers, that went to make up a bobbin for a coil on an electrical instrument. One washer on each coil carried three tags, one end of which screwed into the washer; and the other was flattened and drilled to connect a wire. These tags were made of No. 12 Birmingham wire gage brass wire and threaded. The washers were ⅛ inch thick and, allowing for the point of the drill, there was about 1/16 inch of thread, or three full threads in each hole, there being 47.9 threads per inch on a 6 B. A. screw, the depth of the hole being just over half the diameter.

To tap these by hand was out of the question, as there were some thousands to do, so some special rig had to be made to do the job. Fig. 1 is a small tapping machine of German make, I believe, and will be recognized by many of your readers. The rear pulley *A* was set back a little and the spring on the end of the spindle was taken off and replaced by the one shown at *B*, which is a little stronger than usually used. It was slotted and fitted easily into the groove *C*, turned in the end of the spindle. When this spring was set, it held the friction disk *D* away from both friction drives, and so the spindle remained stationary.

Fig. 2 is the rig attachment to the slide of the machine. It consists of a brass block *A* which was drilled through the center and tapped for a No. 6 B. A. screw. *B* is a plate on the front on which the work was located, resting in the V shown in front view, Fig 4, and on the locating pin *C*, bringing the hole to be tapped in line with the tap. The parts *A B* are clamped to the slide with screws *D D*. When the taps were made for this job, they were fluted about ¼ inch only, so that only the plain or unfluted portion of the tap ran in the brass block, in order that it would not cut away, or wear out the thread quickly.

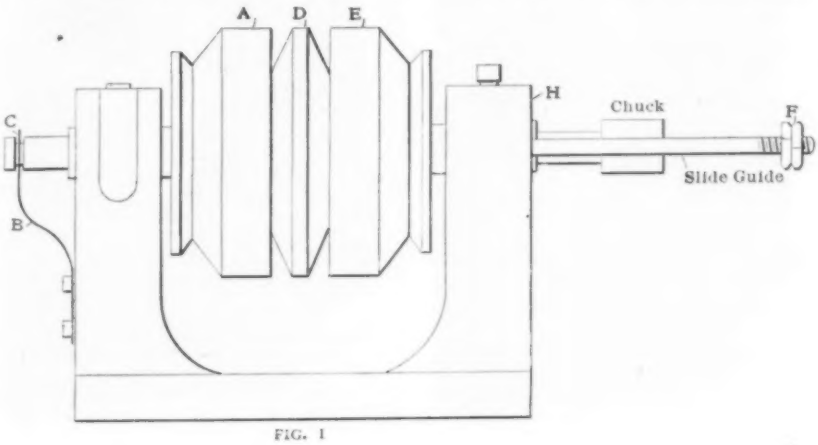


FIG. 1

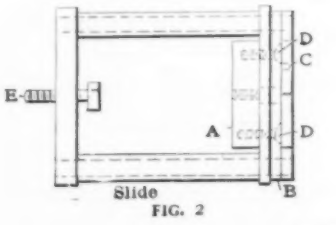


FIG. 2

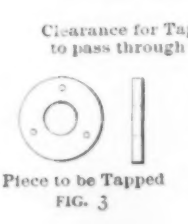


FIG. 3

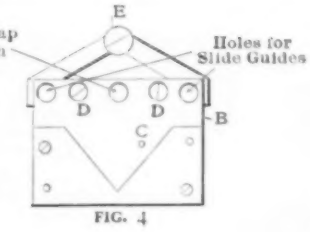


FIG. 4

TAPPING SHALLOW HOLES

To do the job, the operator places the washer in position, holding it with thumb and finger against the plate *B*, pushing the slide forward. In doing so he engages the disk *D*, Fig. 1, on the spindle with the pulley *A* running forward, his slide advancing until stop screw *E*, Fig. 2, comes in contact with face *H*, Fig. 1. The tap in the block now acts as a lead screw and with the assistance of the spring disengages the spindle. The stop *E* is set so that the tap shall be at the bottom of the hole in the washer.

To withdraw the tap he pulls the slide back and so engages with pulley *E* running backward, until the slide comes in contact with lock nuts *F*, Fig. 1, which act as a stop and prevent his drawing the slide too far forward, the tap again acting as a lead screw disengaging the disk *D*. The spring draws the spindle into a stationary position ready to repeat the operation.

J. V. HART.

A Simple Method of Dial Graduation

Once upon a time, perhaps 20 or more years ago, when the question of dividing circles was under discussion, I suggested through the *Journal* of the Franklin Institute, that if it was possible to grind accurately a number of bushings of the same size and concentric with the holes of the same diameter, that if any given number of these bushings were tightly inclosed in a ring, holes drilled through the bushings would be accurately spaced and concentric. The plan contemplated involved great cost and the uncertainty of making the bushings accurate.

Since that day the making of practically accurate balls has been developed, and this idea presents itself: Bore out a ring that will embrace the required number of balls. A drilling jig with two points that will fit between the balls ought to space a circle with a good deal of accuracy. The ring would be used to make the smallest circle first, then bored out for the next, etc.

It is likely that the number of balls required could be selected to an accuracy of one ten-thousandth of an inch, if not closer; and with the two-point contact, divide the error, if any, by two. The ring could be slightly heated to go over the balls, and a slight shrinkage would set them right.

JOHN E. SWEET.

Automatic Coin Weighing

Walter Gribben, in his comments on "Automatic Coin Weighing," at page 165, has overlooked the fact mentioned in my article, that a bag of gold eagles, containing $5000, made up of coins of promiscuous weights, all, however, within the limits of legal tolerance, must weigh a specified amount, namely, 129,000 grains with a tolerance of 4.8 grains. It is necessary to separate the "lights" from the "heavies" in order to enable the counters to make up this weight.

The operation of mixing the coins is, in general, as follows: The counter places five hundred eagles taken from the box of "heavies" in the scale pan, and notes the approximate amount of overweight. He then removes from the pan a number of coins, five or ten at a time, and replaces them with the same number of coins taken from the box of "lights." If the total weight is still too great, he repeats the operation, and so on until he gets the five hundred coins to weigh the proper amount.

A. LESLIE LAMBERT.

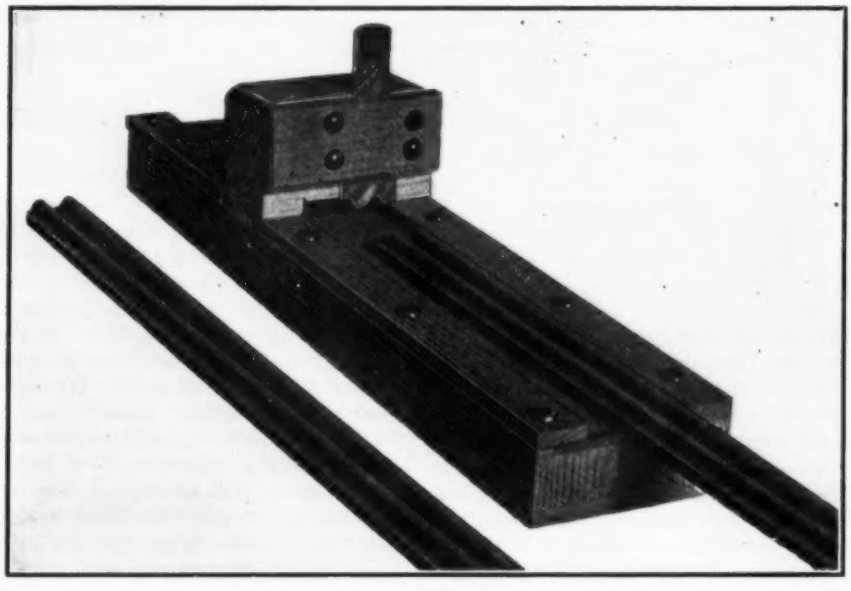
A Simple Wire Straightener

Some time ago, while I was working in a small shop in Chicago we had a job on which we wanted to use a quantity of hard drawn brass wire about 0.085 inch in diameter, as I remember it. The wire was delivered to the shop in a coil and had to be straightened. As we had no straightening apparatus—at least, so I thought—I was interested to see what the foreman was going to do with it, when I found out he intended to do the job.

He soon "showed me a trick with a hole in it," however; for, taking a piece of brass tubing about ⅛ inch inside diameter, he made a gradual bend of about 30 degrees in it about 3 inches from one end. He put this into a Hendy lathe, put the belt on the high-speed step of the cone, and fed through about a foot of the wire, taking hold of the end with a pair of heavy pliers. He then told me to start the machine. This I did. When he drew the wire through, it came out with every bit of curl taken out of it. We straightened several hundred feet of wire in less time than it takes to tell about it, without marring it in any way. M. R. KANTIC.

A Special Cutter for Pattern Work

The special tool shown herewith was used in making about 80 linear feet of the strip shown for some filter plate patterns, a quantity which was not large enough to justify taking more time in making a better tool. This one was made in 2½ hours, and the time of making the tool was more than saved, besides the advantage of getting all the pieces alike. They were run over the buzz saw, and most of the stock removed before using the special tool on them. All of the pieces were pushed through the tool, reversed end for end and pushed through again, making two cuts on each; the cutter was then set down, and the process repeated until the desired form of strip had been attained. J. L. GARD.



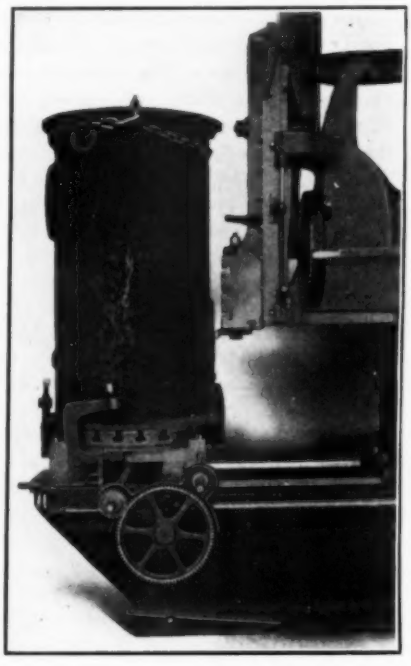
A SPECIAL CUTTER FOR PATTERN WORK

A Large Slotter Job

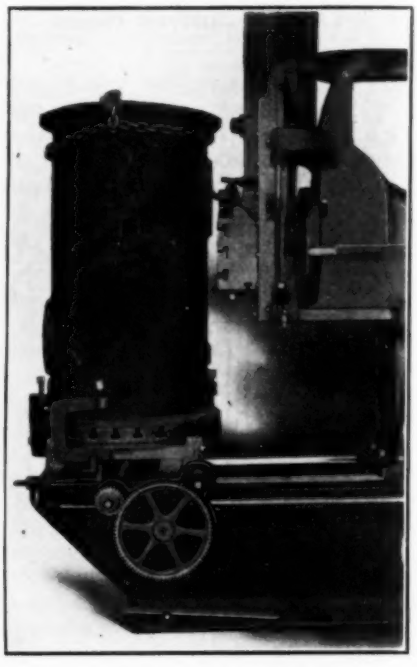
The inclosed photograph shows a Dill slotter at work on a job almost too large to be handled. It also shows how it was completed, and should prove of interest to a number of your readers.

It will be noted that the special tool bar and relieving tool apron were brought into service in facing off the pipe joint for the cast-iron superheater. The same tool bar was used on the other joint with the tool reversed and doing the cutting on the up stroke. Of course this is not quite as convenient as cutting in the usual manner, but taking into consideration that these castings weigh 2750 pounds, are 4 feet 10 inches high and 34 inches in diameter, and the facilities at hand for handling them, it was the best that could be done. This made it possible to machine the joint on the top in less time than the casting would be turned end to end and clamped down again.

M. H. WESTBROOK.



CUTTING ON DOWN STROKE



CUTTING ON UP STROKE

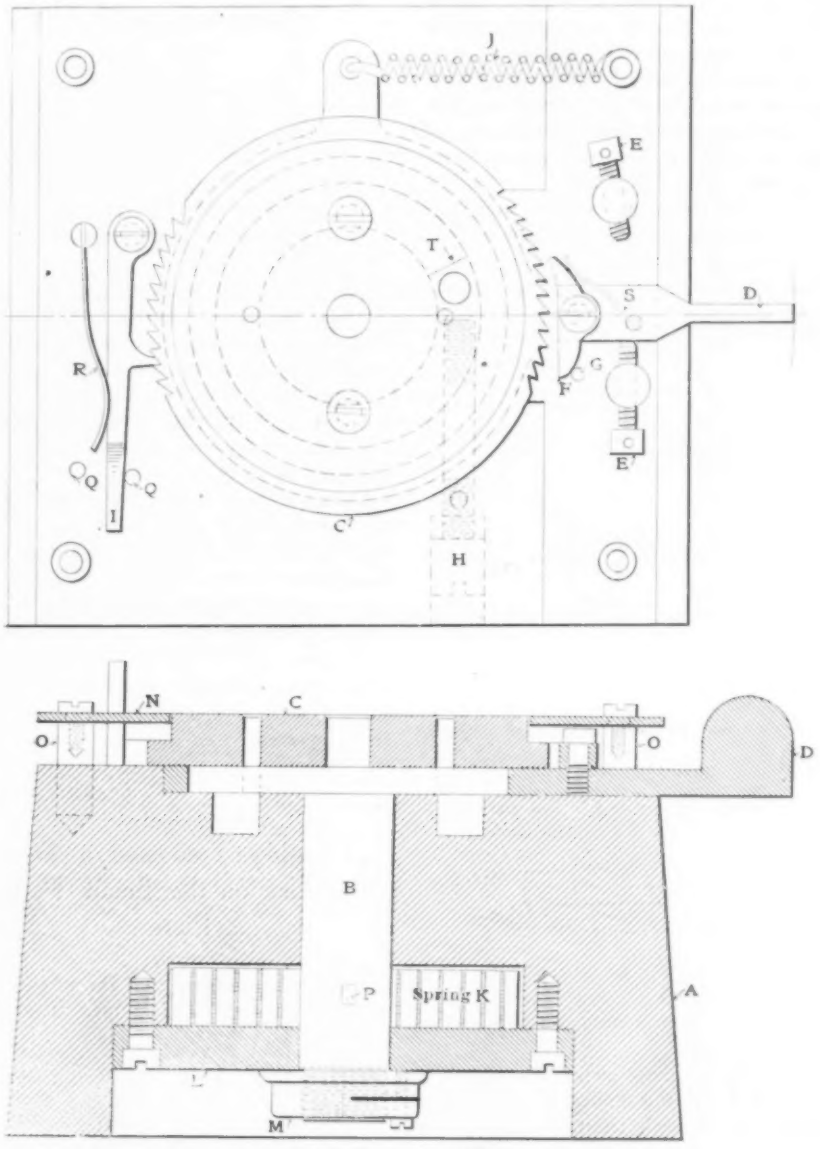
An Index Device for the Numbering Machine

Until a short time ago we used two different types of indexing mechanism on numbering machines. Both kinds were, to use a common expression, "something fierce" to deal with. They were exceedingly complicated and, like a ladies' watch, "always out of repair." I have seen them, one after another, come down at short intervals into the machine shop for some poor unfortunate to perspire over; and have myself had the pleasure (?) of reassembling one which had been dismantled for cleaning.

It happened shortly after this pleasure that a new numbering machine was being built, and I was ordered to fit one of the old fixtures to it. Remembering well, however, the trouble caused by this same fixture, and desiring to simplify matters somewhat, the device shown in the accompanying illustration was the result.

Referring to this engraving, *A* is a cast-iron block and is the body of the device. The steel arbor *B* has a disk at the upper

end, on which the plate *C* bears and is held rigid by two screws and two dowel pins, as shown. This plate *C* also has three dowel pins (not shown) which correspond with three holes of fixed location in the piece to be numbered. These pins are used for locating the pieces, as will be described later. A steel lever *D*, shaped as shown in the dotted lines, rides freely about the enlarged portion of the arbor *B* and carries with it the click *F*.



AN INDEXING DEVICE FOR THE NUMBERING MACHINE

Its motion is limited by the stop screws *EE*. While at rest this lever is held against the forward stop screw by the spring *J*, and the click *F* is prevented from engaging with the teeth on *C* by means of the pin *G*, which extends high enough above the casting to allow the tail of the click to ride against it.

The pawl *I*, whose office will be described later, also engages with teeth similar to and opposite to those at *F*, cut in the rim of the plate *C*. The arbor *B* carries a lug *T* on the under side of the disk. A circular channel of square cross-section is turned in *A* for its accommodation. The spring *K*, one end of which catches on the hook *P* and the other in a small slot in *A* serves to keep the lug *T* against the end of the screw *H*. The plate *L* is merely to permit the endshaking of the arbor *B* by means of the check nut *M* and is held in place by four screws. A guard plate *N* is supported on posts *OO* flush with the top of *C* and has a slot cut in it to accommodate the pawl *I*, which rises above it to allow for tripping. Two stop pins *QQ* limit the travel of the pawl *I*; *R* and *S* are flat steel springs whose use is self evident.

The operation of the device is as follows: It is placed in the machine and, after having been located so that the figure will be stamped the proper distance from the center of the plate, it is locked in that position. A trial piece is laid on *C*, the dowel pins locating it and preventing it from slipping. By means of the screw *H* the piece is so adjusted that the figure will be stamped in the correct place on it. All adjustments having been made, the operator takes the lot of pieces to be numbered, places one on *C*, where the first figure is struck in the usual manner. Next he presses lever *D* with the thumb or forefinger of his right hand, and causes the click *F* to ride down from the pin *G* and engage with the ratchet teeth in *C*. The rear stop screw *E* is adjusted so as to allow the lever *D* to ratchet *C* forward only one notch. As the pitch of these notches is exactly the same as the spacing required for each figure or character, it follows that the piece will now be in position for the second blow. On releasing the pressure on *D*, the spring *J* draws it back to its original position and the pawl *I* retains *C* in place ready for striking up the next figure.

This operation is repeated until the piece is numbered, when it is removed, and the operator trips the pawl *I* with his left thumb, thus allowing the spring *K* to pull around the arbor *B* and with it the plate *C* until the lug *I* stops against the end of the screw *H*, which was its position in the beginning. It is obvious that the spring *K* must be in a state of sufficient tension to pull the lug around firmly against the end of the screw, otherwise the spacing of the figures would be spoiled and the device valueless. The guard plate *N* facilitates rapid handling of the work, and keeps out undesirable dirt and chips.

F. W. B.

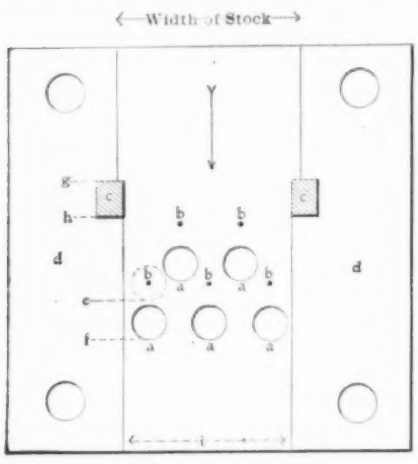
A Register for Press Tools

In the press tools which I will describe, absolute register is obtained without the use of pilots. The methods are well adapted for blanks containing small holes, say 0.032 inch in diameter; too small in fact, to use pilot pins successfully. A disadvantage with pilot pins is that they often pull the blank out of the die, and with a rapid feed there is liable to be disaster to the tools.

The illustration shows a simple washer die; but the reader will see that many other shapes can be as easily used. Referring to the illustration: *a* shows the cutting holes, *c* the side punches, *b* the piercing holes, and *d* the side plates. It is the use of the side punches which gives success to these tools, and care must be taken that the distance from *e* to *f* corresponds with that from *g* to *h*. This is obtained by taking the diameter of the blank, say 0.25 inch, and adding the allowance for scrap, about 0.032 inch, thus making the distance between *e* and *f* 0.282 inch. This is also the length of the side punches *g* to *h*.

If this is correct, all that is necessary in working is to pull the strip by hand and five complete blanks will be struck at each revolution of the press. Of course, any number could be put in, such as three, five, seven, nine or eleven, but as a rule

five is sufficient. The stock is cut into strips about ⅛ inch wider than the distance *i*. This allows 1/16 inch to be clipped from each side of the strip and



A REGISTER FOR PRESS TOOLS

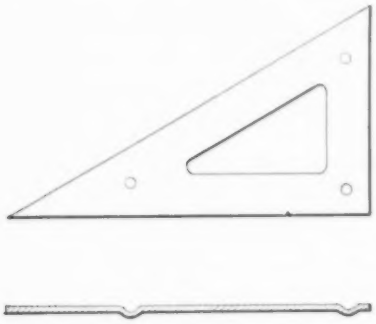
lets it pull forward the exact length of the punches *c*, thus giving absolute precision and locating the position of the piercing holes to such a nicety that the resulting blanks are perfect in every way.

In the illustration I show very small piercing holes, but with any size of holes these tools have always shown a great advantage even where pilots could have been used. I will mention one other detail, let all punches work through a tight stripper plate which also forms a guide plate (the French style) and you will find that the tools will last much longer, and that the results will be infinitely superior to the open stripper plate. They require little or no skill to set up in the presses, retain their cutting edges longer, and are well adapted to produce first-class, accurate work. O. D. CLERKENWELL.

B——, England.

A Triangle Kink

It is sometimes difficult to pick up an ordinary celluoid triangle. I find a good way to overcome the difficulty is to lay



A TRIANGLE KINK

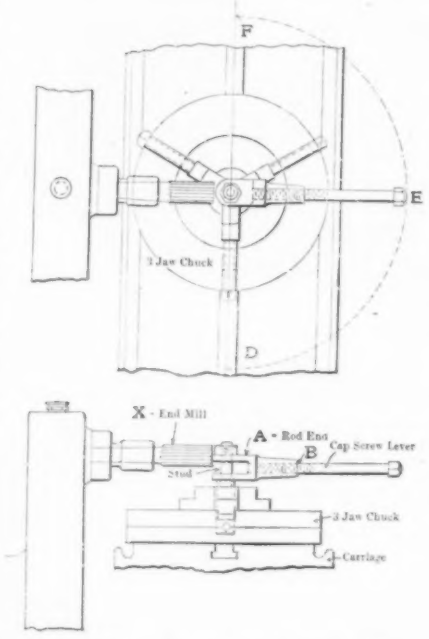
the triangle on a flat block of wood and put three dents in it with a round-nose punch, as shown in the sketch. These will act as legs and keep the edges of the triangle off the paper. It is also convenient for a tracer. If he should skip a line, he can push the triangle back over the wet ink with no danger of blotting his work. W. A. SAWYER.

An Emergency Radius Milling Job

About two years ago I was working in a factory which used a great many rod ends, such as shown in sketch marked *A*.

We were all out of the forgings and were unable to get them quick enough for a "hurry-up" order that we had, so we made up a lot of about two hundred out of ¾-inch stock.

They were all right, with the exception of rounding the ends to a ⅜-inch radius, and when it came to this operation I found I had no radius cutters of suitable size to mill them, so I rigged up a little



AN EMERGENCY RADIUS MILLING JOB

fixture like the one shown in the sketch.

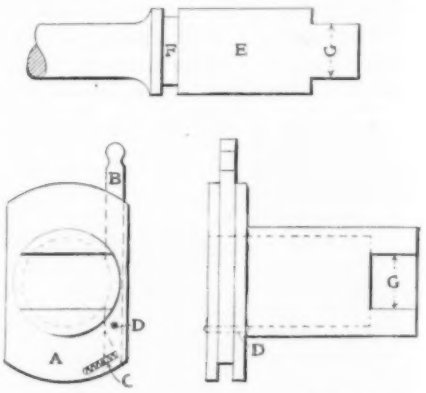
I took a Pratt & Whitney hand miller which had a chuck on it, and which we usually used for slotting screw heads, etc. I turned up a stud the size of the hole through the shank, cut a thread on the end of it, and put a nut on it to hold the piece in position. I set this stud in the chuck on the carriage of the machine and, with a long cap screw for a lever, screwed into the rod end as shown at *B*, it was a very simple matter to swing the piece back and forth through the arc *D E F*, so that I obtained the proper radius against the end mill *X*, at the same time gradually feeding the carriage upward.

This way I managed to round all the ends to the proper radius in about three and one-half hours. A. A. DOWD.

Quick-change Holder for Turre-

The drawing shows a quick-change holder for machine reamers to use in turret lathes.

The holder *A* is made from a solid piece



QUICK-CHANGE REAMER HOLDER FOR TURRET

of machine steel and case-hardened. The shank is made to fit the turret, and is bored to fit the reamer. It has a slot milled through the end of the shank with the slitting cutter, to fit flats milled on two sides of *E*.

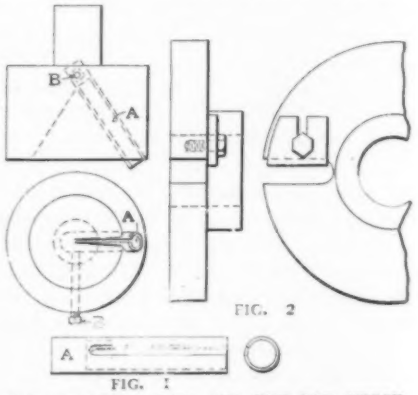
A lever *B* fits in the milled slot in *A* and has the end beveled off enough to clear groove *F* in *E*, for removal of the reamer.

A spring *C*, in compression, helps *B* retain its position. *D* is a small pin which holds lever *B*. *E* is a shank showing groove *F* by which *B* keeps *E* from working out of *A*. *G* is a flat on opposite sides (not squared, i. e., not four sides of shank) which keeps *E* from turning.

FRANK LANG.

A Pointing Tool and a Device for Use on the Small Face Plate

Fig. 1 is a pointing tool for screw machines with a circular cutter. The cut-



THE POINTING TOOL AND THE DOG CHECK

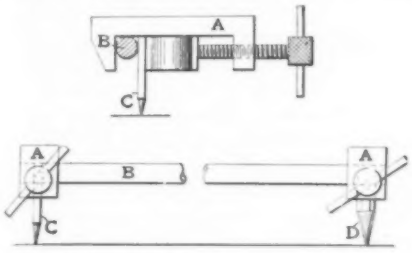
ter *A* is not hollow the whole length in order to leave a solid spot for the set screw *B* to press on. These tools are being used extensively on brass in our shop.

Fig. 2 is a little device to take the slack cut of the dog when the lathe is reversed, especially when cutting threads.

GUSTAV LINCKE.

An Emergency Beam Compass

The accompanying illustration shows a beam compass which I once made and



AN EMERGENCY BEAM COMPASS

used when no other was available. It served the purpose to my satisfaction.

Two toolmakers' clamps, such as shown at *A*, were borrowed from a toolmaker, and a piece of rod *B* long enough to swing the radius was procured. One end of the rod and a pointed pin, as shown at *C*, were fastened in one clamp. The other end of the rod and the pencil *D* were secured by the other clamp. The work was done and nobody knew but that I had used a regular beam compass. The cut shows how it was rigged up.

CARL ARMERDING.

Folding Blue Prints

The illustration shows a convenient method of folding blue prints so that they may be carried in a grip or in the pocket. The print is first folded as in Fig. 1, the blue side up, and the title in the lower right-hand corner, as shown. The folds are about three inches wide, making a convenient size for the pocket. The

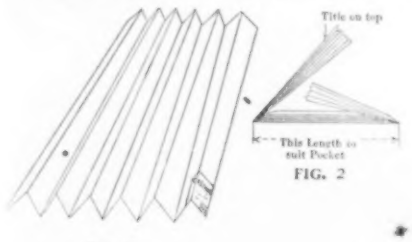


FIG. 2

FIG. 1

FOLDING BLUE PRINTS

prints are then folded again as in Fig. 2, and the addition of a rubber band around it makes it of small enough compass so that a number of prints may be conveniently carried in the pocket or grip, with all titles or at least a portion of each title in plain view. For reference on the table they have the advantage of ready reference in that the folds may be opened at any point in the length of print if it is desired to look at only some small portion.

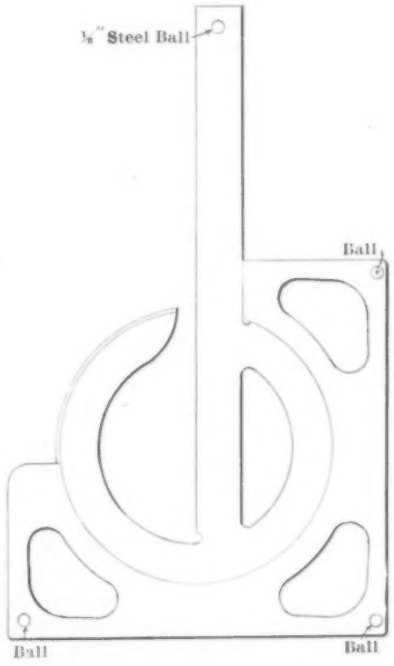
W. E. M.

A Draftsman's Protractor Kink

No doubt many of your readers have been troubled with dirty drawings from the use of flat metal protractors.

The following kink, as applied to a Brown & Sharpe protractor, overcomes this difficulty and at the same time makes the instrument easier to pick up from the board.

The arrangement is very simple. It consists of four ⅛-inch diameter steel balls, pressed into holes drilled approximately in the positions shown in the illustration. They should project an equal amount from each side; thus there are four bearing points instead of the complete surface. Since making this alteration I have had no further trouble and can commend it to anyone using a similar instrument.



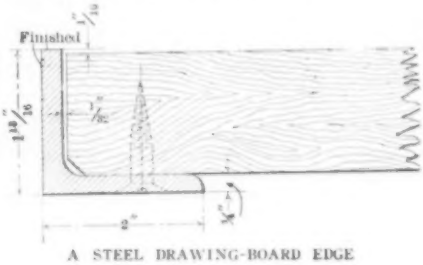
A DRAFTSMAN'S PROTRACTOR KINK

S. W. MILLS.

A Steel Drawing-board Edge

One of the difficulties a draftsman quite frequently bumps up against is that of trying to draw long lines parallel to each other. When drawn, he often finds that instead of being parallel throughout they are from 1/16 inch to ¼ inch farther apart at one end than at the other. This condition is almost sure to be found in steam-heated offices where the cross-grained end of the board is depended upon to make a straight edge upon which the head of the tee square is expected to slide.

The accompanying cut shows an arrangement that I have on my drawing board for overcoming this difficulty. I find that it answers the purpose admirably. The straight edge is made from a piece of 2×2×¼ inch angle iron planed or otherwise finished on the top and outside edges to insure its being perfectly straight. The top edge projects about 1/16 inch above the surface of the drawing board to give the tee square clearance above thumb-tack heads and small particles of dirt when sliding up and down, thus preventing the grinding of dirt into



A STEEL DRAWING-BOARD EDGE

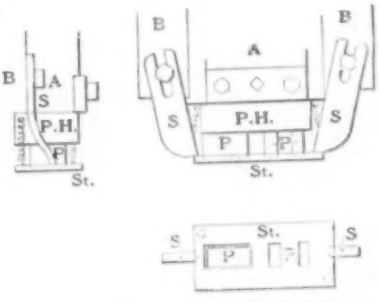
the paper with the square. The angle iron is secured to the drawing board by one 1¼-inch No. 15 wood screw located about 5 inches from each end, as shown. The screw hole in one end should be slightly slotted to take care of the swelling or shrinking of the wood.

E. W. BOWEN.

A Stripper for a Punch Press

The illustration shows a form of stripper which we are using on a number of dies where the article is formed in the die and thrown out by a knockout, the press being inclined, and where the punches cannot be long enough to allow for a stationary stripper.

It is cheaper to make than one held to the punch-holder by screws and backed with springs, is positive in action, and keeps the metal up out of the way



A STRIPPER FOR A PUNCH PRESS

long enough for the article to slip off the die.

The stripper slides freely on the punches and on the down stroke is drawn up to the punch-holder by the two springs; when the slide goes up the metal is stripped, just before the top of the stroke, by the two stops.

A is the press slide, *B B* the guides, *P H*, the punch-holder, *P P P* the punches, *S S* the stops, and *St* the stripper plate.

W. A. BROWN.

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Contents

	PAGE
New Development in Air Compressors	249
Inexpensive High Speed Tools	252
More About Filing Systems	253
Wheel Truing Fixture for Surface Grinding	254
Making a Sub-press Die	255
Speeds on the Grinding Machine	256
Side Lights on Shop Questions	257
Molding a Tapering Pipe Bend	258
Some Automatic Screw Machine Tools and Appliances	260
Suggestions to Applicants for Positions	261
Aluminum Alloy Founding Practice	262
American Machinery for Egypt	265
Dies for Making Square Pans	266
American Machinery Defended	268
Standard Proportions for Machine Screws	269
Hardness Standard for Hardened and Tempered Work	271
Practical Letters from Our Readers: Pipe Bending Rig..Impression Dies for Hard Rubber....Making Press Dies....Who Will Do the Hard Work?....More About Internal Grinding....Turning Rubber Rolls ....Tapping Shallow Holes....Simple Method of Dial Graduation....Special Cutter for Pattern Work....Large Slotter Job....A Register of Press Tools....Emergency Radius Milling Job....Quick Change Holder	272
Factory Employees' Relief Associations	280
Honesty in Little Things	280
The Personal Touch	281
Inventing and Designing	281
New Tools and Machine Shop Appliances	282
Good Work—Cheap and Otherwise	282

Factory Employees' Relief Associations

Many of our large machine shops have vigorous mutual relief associations among their employees. These go under different names and are organized and conducted in different manners, yet their aim is the same, the welfare and aid of their members.

They perform a very commendable work. Before their general adoption, a case of distress of a workman was usually aided by his shop-mates through a subscription paper or through private donations. Such methods, while showing the kind impulses and generosity of the givers, sometimes tended to unfortunate results. They fall into the class of misdirected charity and with some individuals tend toward a lack of thrift.

The relief association, on the other hand, with its active organization, its stated dues and stated payments, is free from these objections. These organizations are in some cases managed and officered entirely by the employees themselves. At other times the managing officers are composed of employees and employers both, and in still other cases the employers bear the executive burden of the association. In a few cases paid secretaries are employed; in general, however, the services of the officers are voluntary or their recompense is nominal.

Many problems have to be seriously considered and wisely solved in order to organize and maintain properly a vigorous mutual benefit or relief association. In the average machine shop there is a large variety of help, as, for instance, the machinists, molders, drafting-room help, office help, laborers, foremen, women, etc. Among these different classes there is a wide difference of payment, ranging, perhaps, under average conditions, from $4 per week up to $35 per week. At the outset the questions of dues, assessments, sick benefits, death benefits, requirements for admission, suspension, medical examinations, etc., must be wisely settled in order that there may be at all times a sufficiency of funds to carry on the work properly, and still the amount of money taken from the members must not be excessive. In connection with all of these questions is the one of the probable number of persons who will form the membership.

A short time ago the paid secretary of a machine-shop mutual benefit association which has a membership of from 1500 to 1700, suggested that if the secretaries of such organizations throughout the country should form a secretaries' association, much valuable information could be exchanged to the benefit of all. General machine-shop conditions of employment are undoubtedly more or less uniform throughout the country, and for such a specific industry the vital statistics should be as capable of careful tabulation as are the statistics of an insurance company. Therefore a secretaries' association, or any means whereby the secretaries of these various organizations can be brought together and exchange ideas, should be of considerable benefit. If the other fellow is working along lines similar to your own, it is usually well worth while to find out what he has done, and what he is doing.

Honesty in Little Things

Is there any difference between the rights of ownership of a large corporation or manufacturing firm and of a private individual in what are usually considered as little things? Many factory employees act as if they thought that such a difference exists and, while they would not take small quantities of material, for their own use, from a neighbor, they do not hesitate to appropriate such things from their employer.

If the chicken yard at home needs a little repairing, it is very easy to take home a double handful of nails in one's pocket; a couple of dozen wood screws are easily carried away; or, perhaps a pantry shelf is needed and a piece of board from the pattern shop serves the purpose nicely. Of course the few nails look small compared with the hundreds of kegs in the storehouse; a dozen screws are not many compared with 50 gross on the shelf; and two or three feet of pattern stock leave no hole when taken from the thousands of feet in the loft. Yet wages are not paid in nails or screws or boards.

Shop foremen do not always set the best of examples along this line. A foundry laborer was once caught with a quantity of composition scrap which he was attempting to carry away. This material he had gotten from machine parts in the iron scrap pile. His foreman attempted to defend him by saying that it was a good thing to keep the composition out of the cupola. While this statement was true, the laborer was robbing the company in two ways: in the metals taken and in his time spent in gathering them.

This feature of appropriating is sometimes carried to an extreme. A certain pattern shop was kept busy for weeks on mahogany furniture for an office clerk while rush shop patterns were sent outside to be made.

Opposed to this condition we have known men who would take nothing, not even the smallest object, from their employer's stock. Their position, while it may appeal to some as extreme, is right. The little things are as much the employer's property as the larger ones, or as the money in the paymaster's cash drawer. A habit of strict respect for such property rights should be maintained. The Good Book says in substance: He that is faithful in that which is least will be faithful in much.

The Personal Touch

There is a growing feeling among many manufacturers, especially in the smaller shops, that their organizations should do more toward getting in close touch with their men with a view to counteracting the work of agitators who are trying to foment trouble by inciting the feeling of class distinction.

The idea is not to do things for the men in any special way, but rather in getting into closer touch with them as was easier in the old days and encouraging them to do things for themselves that will make them more valuable to the employer, to the community and to themselves.

One of the first steps advocated is the endeavor to foster and promote a desire for reading the best papers of the day in their line of work. This is being done in several ways. Some subscribe for them and give them to the apprentices and to some of the men. Others designate a clerk to act as agent and get the benefit of club rates for each of the men. Still another way is to let the men pay for the papers in instalments, the idea being to encourage reading and to show the men that an interest is being taken in their welfare, the incidental benefit to the papers themselves being of secondary consideration, and the cost of the clerk's time being considered well invested if the men can be encouraged to read.

Another step is the doing away with as many arbitrary rules as possible and still maintain discipline in the shop. It is believed to be better to have a foreman speak to a man who may be doing work in an awkward way or perhaps straining a rule a little, than to post another notice, perhaps No. 71 on the list, for all hands to see and abide by ever after.

After all it means introducing a little more human interest and a little less of the frame of mind where the men are simply "hands," nameless perhaps and known only by a number the same as the machine they operate. Now there is no reasonable objection to a man having a number, as it is the easiest way of keeping time, costs of work and looking after tools; but it is better in every way to have him Jim or Charlie to the foreman and to the superintendent. It's more human and better in every way. A few seconds spent in inquiry for a sick wife or child, unless it is evident that it is done for policy only, will do more good than all the talks on betterment work you can give in the shop.

By showing an interest in the men they will be interested in you and your work. If they are not, they are not the kind of men you want. This interest can also take an educational turn that may go far toward solving the problem of supplying skilled mechanics, and a little time spent in conferring on this important point at each meeting ought to develop some general plan which can be modified to suit varying conditions.

Perhaps the best way to impress on the men the desirability of learning is to point out that the skill and ability they gain cannot be taken away from them, but remains theirs no matter where they go and makes them able to command better positions and higher wages. It is better, however, to show them that your self interest is in securing better mechanics than to let it appear as though the gain were all on their side.

Men are suspicious when something is offered for nothing, and rightly so, for there is nearly always a string on such a proposition that makes it undesirable. Men admire frankness and will work with a better feeling if they can see your side of the proposition plainly instead of wondering just how big a slice you are getting out of it. They are very apt to make this several times too large unless they know.

Summed up in a few words, it means that many feel that conditions would be better if more personal interest were displayed, if education along practical lines were encouraged and the personal touch between managers and men were as close as circumstances will permit.

Inventing and Designing

Inventions and patents are regarded as having contributed much to our industrial progress; and this viewpoint is just. It is probable that the average impression in regard to an inventor is, that he is one who starts with a hazy idea and at length through some creative process evolves a new device or method. There is usually no real appreciation of the hard labor, thought and anxiety which led to the result.

The impression in regard to the starting point of many inventions is, however, by no means wrong. Many of the greatest inventions have been made by men who had no especial training in the field in which they were working. Yet they grasped fundamental principles and produced far-reaching results. Many of them worked on and on for the real love of investigating and discovering without adequate returns for their labors.

Modern methods have brought in a new type of investigator, worker and patentee whose results parallel those of the inventor. To men of this class we prefer to apply the term, designers. Some large corporations employ from a few to many trained men who do nothing but work out new things connected with the line of production in which they are engaged. The suggestions and inspirations for their work usually originate outside of themselves, but the processes of development are almost identical with those of the inventor. They, however, are in no way hampered for means or material or appliances. Everything in the way of improved machinery and skilled workmen is at their disposal. They are usually employed on a fixed salary, and all of their production passes absolutely into the ownership and control of the corporation for whom they work. Thus their manner of life is entirely different from that which we usually think of as belonging to the inventor.

This condition has a tendency to, and in some cases does, work hardship to the real inventor. He is outside of the fold of the corporation, and while his results may be meritorious and useful the field for exploitation is controlled. He must sell his patents or developments to only one bidder, or perhaps to one of a very few, all of whom have a gentleman's agreement in regard to such matters. This agreement usually does not work to the advantage of the inventor. In comparing two devices for the same purpose, one developed outside of the corporation organization and the other within, the latter naturally has the preference; although merit might lie with the other.

Another way in which the work of independent inventors is hampered is by what is shown as hedging patents. These are usually taken out by large corporations from one of two standpoints, one of which is to surround and protect a patent which they are exploiting by others, in such a way as to make it difficult to perform the same operations or reach the same result by similar or parallel means. The second standpoint is to surround the invention of another by a series of patents so as to limit its scope and application to just what may be specifically claimed; a method, which, when applied to mechanism, often emasculates the original invention.

The work of designers is often of the highest quality and productive of real advances in the art in which they work. Yet it is often stated as a fact, and observation would tend to prove its truth, that the greatest inventions, the longest strides in a given art, are made by men not directly connected with it. These men belong to the class which we have referred to as inventors, not to the class of designers. In the life of the designer the great spur of necessity is wanting; that force which has given birth to so much that is of the best in our industrial development and the expression of which has crystallized into the threadbare yet true statement "necessity is the mother of invention."

In view of these conditions are not some of our modern designing methods unfortunate; or stated a little differently, do not some of our modern designing methods work a hardship to the independent inventor in many arts? This should be studied carefully, for the work of our real inventor is of too great value to our industrial advancement to be hindered in any manner. He should be aided and protected in his creative work.

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

A Drill Chuck

The illustrations show an automatic drill chuck. By referring to Fig. 2 the action of the jaws may be understood.

Four multiple sets of gripping jaws *B*, in cam form, are constrained by pin and slotted plate device to work in harmony. Slight spring action causes a constant tendency of the jaws to close, thus giving a light contact upon the drill shank *C* when inserted. The resistance offered by the work tightens the grip of the jaws.

The gripping is secured by a toggle effect, the jaws being so formed that on no size of drill can the toggle be closed completely; that is, locked in its grip.

Release of the jaws is effected by means of the nurled sleeve outside the shell. The movement to open the chuck is arranged to be opposite to the drill-press spindle rotation. Thus the operator of the machine opens the chuck, to remove or insert a drill, by simply grasping the nurled sleeve. The spindle rotation then instantly spreads the jaws, which close again lightly—either empty or onto a new drill shank—when released.

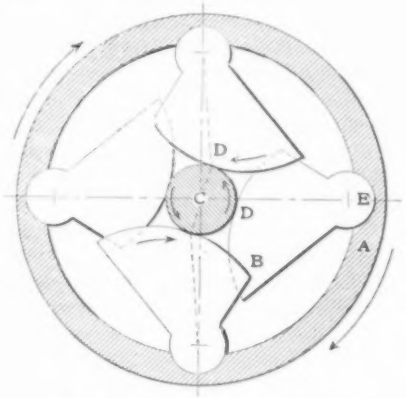


FIG. 2. SECTION OF THE CHUCK

This device is being manufactured by the Davidson Chuck and Machine Company, 524 W. Sixtieth street, Chicago, Ill.

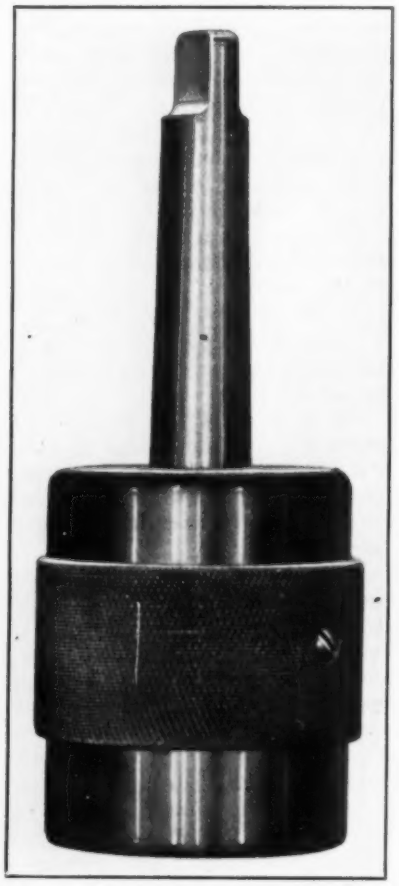
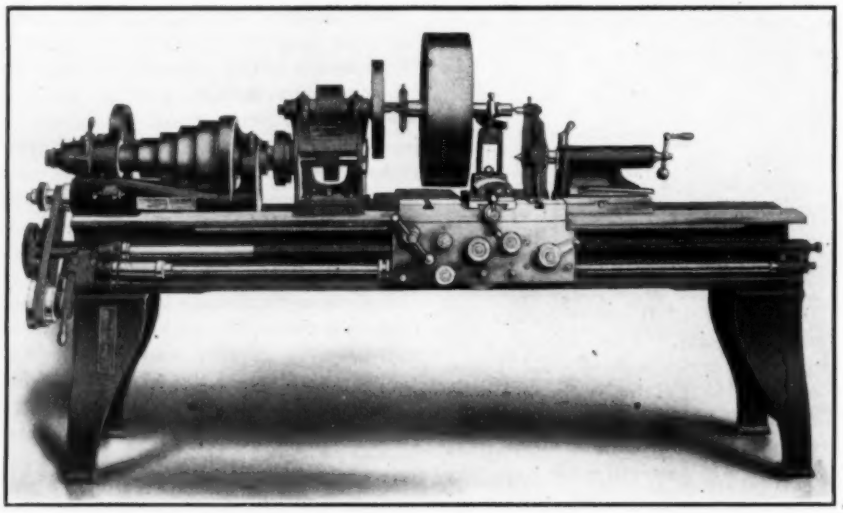


FIG. 1. A DRILL CHUCK

An Increase Swing Lathe Attachment

The illustration shows an attachment for increasing the swing of a lathe so that large work may be handled. The illustration shows the attachment applied to a 16-inch Bradford lathe. A 24-inch pulley is on a mandrel, between centers ready for turning. The head stock of the attachment is geared down 1 to 2, which would give the same speeds as a 26-inch lathe. The attachment is furnished ready to go on the lathe and includes head and tail pieces, tool block, wrench, face plate and centers. It takes less time to apply to a lathe than elevating blocks and there is no liability to destroy the alinement of the head stock. The spindle is made of spindle steel and cut gears are used. This attachment is made in eight sizes for lathes of any make from 12 to 20 inches swing inclusive, by the James Saunders Company, Dayton, Ohio.



AN ELEVATING ATTACHMENT FOR A LATHE

Good Work — Cheap and Otherwise

By W. H. Booth

Good work can undoubtedly be done with poor appliances, and it has been said that it is the poor workman who complains of tools. With an equipment of ordinary hand tools a really trained and skilful man will put together work which is in a sense perfect. The trouble with it is that it is not to any particular gage; it will not measure between any reasonable limits of accuracy or toleration, and it is in no sense possessed of the quality of interchangeableness, that would enable a new part to be sent to replace a broken one. Any such part would have to be sent partly finished, and much the same skill as produced the original would be required in putting it into shape and fitting it to its place. The work when done was all right for that particular machine and that particular place, but what it cost would today place it outside the limit of commercial lines.

Machine tools and gages and shop systems have not produced better or more reliable work than the old hand methods, but they have rendered possible the modern machine of the sewing-machine or printing-press variety, which is both good and interchangeable. Moreover, the men who did the good work of old have naturally gone to other places and have not been replaced, and today the old class of work could hardly be carried out at any cost; unless it might be by the class of men who are included under the head of "toolmakers," men who have things to do that lie outside the ordinary run. There are and always will be men who are naturally skilful, true craftsmen; but the production of such men has been cut down, very properly no doubt, by modern necessities.

Seeing how much time went to the production of an old-time machine, it was proper and right commercially that its life in years should be extensive. In those past days every machine of large size, such as a steam engine, was apt to have some sort of a personal characteristic or individuality. It was made for its place and parts of it were built into the house in which it stood. It embodied certain characteristics possessed by few or no other similar machines. Engines of a given power and with some distinct modification of design or some special detail would be known as sharing such special peculiarities with certain other engines. Thus a pair of large engines would be referred to as only to be seen in a couple of English towns and in St. Petersburg. Members of some old firms could give the age of some engine because it was put up when such and such a person was 2 years old or when John had the measles. Those engines entered into family life in a way that no machine can do today.

The old ways have gone the way of the old work, and while one may regret something of the old ways there is much that is best past. There is, for example, that old four-square ¾-inch hand tap. We may very properly regret the disappearance of the quality of steel of which that old tap was constructed. I use the word constructed because it best fits the nature and constitution of that tool. As was common in those days, it was cut in the usual way on a cylindrical blank; its head end was larger than its body, so that it had to come back the way it went in. Its cutting edges—if such a term as edges may be used to describe them—were made by filing off the threads on four opposite sides so that these edges were some more or less obtuse angle that any cub may figure out for himself. To turn that tap, especially in a too small hole, was a labor of Hercules. To get it back again was often more difficult. Why it did not twist off, nobody could explain. Any modern tap would have failed with the wrenching to which this was subjected. Every man knew that this tap was costing money right along. It was even covertly suggested that it ought to be lost, but the inviolable rights of property kept us from such a heinous sin and the tap lived on. It may be there yet for aught I know to the contrary, for new ideas did not gain foothold there at any subsequent period. One ⅞-inch tap—I believe it was ⅞ inch, and its then odd size probably accounted for the fewness of its numbers—in a good-sized erecting shop seems poor equipment numerically, but such was the fact.

Now this case may seem extreme, yet it could be paralleled by many more in other, now dead, establishments. Things in other ways would get into a rut and jobs had to be done in certain ways, which had far better have been done differently; but they always had been done so and the way had to go on. Younger men in the place would try new ways, in fear and trembling, lest they should be discovered, and save the firm much money. The work done in this old shop was excellent, but it was because the men could fit and think. They were of the old stamp of millwright-engineers, with little book learning, and a vast fund of practical knowledge. They knew how to move and lift weights; for then very few hand winches were made to handle and move the biggest parts of a steam engine. Today the parts are bigger and heavier, but as they are beyond the capacity of hand tackle there is not so much scheming necessary in lifting them. The overhead traveler does it all.

Commercially it is easy to see how the established industries of Great Britain have so repeatedly contrived to outlive the frequent assaults of competition. There was so much being lost and frittered away in the seeking for the ⅞-inch tap, and when found in getting work out with it, that an expenditure of a few shillings on new, properly grooved taps would have yielded hundreds of per cent. on the investment.

The "steps taken to find wrench," on page 870, are no fancy picture. Many times and often have I traveled such devious paths after some tool, in place of using a direct path to and from the tool room. It was a long time before the tool-room or tool-store idea took hold. If a fully organized tool room was brought to a man's notice, he was aghast at its first cost, meanwhile overlooking the principle of the thing. To such a man it is useless to show too much at once. He wants to start with the principle, get to work in a simple manner and let the thing grow spontaneously, as it will do if the man in charge is of the right organizing sort.

Probably there are still many of the old-time shops going in places. I mean those where every man had a huge tool chest, into which he collected all manner of tools in profuse quantity. At our place every man had a private mark which was stamped by the smith on all of that man's chisels. For example, mine was a miniature of an engine crosshead. Though I was but a cub, I collected some 60 or 70 first-class cold chisels. The stock of older men ran into hundreds. There must have been thousands of dollars' worth of chisel steel hidden away in those boxes; yet only one ⅞-inch tap in the erecting shop—a disproportion that went through all the place. Some concession to humanity might be made if every man was allowed half a dozen privately marked chisels, for I know the personal affection that even a cold chisel can inspire, especially when it is of such quality that it will chip along 120 feet of harsh cast iron at one grinding. Some tools cannot be shared in common, and allowance must be made for this fact. Others are distinctly of the store-room class. A successful manager should know where to draw the line in his organization, for this personal regard for an inanimate object is after all a real factor. It must not be allowed to cost too much, as it often does when a man tinkers up his old engine purely out of sentiment when he ought to buy a new one using only half as much steam.

I have known a Frenchman to weep when his employer removed an old engine and put in a new compound. However, he was soon taking pride in the appearance of his new charge. The same thing happens with old machine tools. They will do good work at a cost, and are allowed to go on costing too much long after they ought to have been scrapped. This is especially the case today, when old machine tools have to compete against heavy new machines using high-speed steel tools. I have known where a single weak tool, on which the general run of work in a shop very largely depended, practically to bring the place to bankruptcy. I have found men who, knowing their work was good and sound, seemed to think that their methods must also be good. So they would not make changes and lost money right along.

I sometimes think that if those who advocate new and improved methods would not be so offensively aggressive in claiming that they will do better work they would have greater success in introducing their ideas. It is not a question of good and bad work, but of doing good work at a price. It is in the cost of the work that the old systems failed to meet competition.

Business Items

The Citronelle (Ala.) Light and Power Company has secured franchise to establish an electric-light plant. An ice plant will also be erected by the company.

The Boston Wooven Hose and Rubber Company, Cambridge, Mass., will increase its plant by the erection of a new foundry building and a four-story hose building.

The Baltimore (Md.) Sash Pulley and Hardware Company has been incorporated to manufacture sash pulleys. Frank S. Clark-

son, Randolph Barton, Jr., and others, incorporators.

The Jeannin Automobile and Manufacturing Company, St. Louis, Mo., has been incorporated. Capital, $15,000. Incorporators, E. P. Fritschle, William Goener, Oscar O. Milentz, etc.

The American Spiral Spring and Manufacturing Company, Pittsburg, Penn., has purchased a site on which it intends to erect a building for the manufacture of special flat and spiral springs.

The Laconia (N. H.) Needle Company has been formed with a capital of $10,000. A plant for the manufacture of needles for knitting machines will be erected. John T. Busiel is president.

On account of the increased business of the Dayton Pneumatic Tool Company in the Buffalo district, an agency has been established with Root, Neal & Company, 178-180 Main street, Buffalo, N. Y.

The Flour City Ornamental Iron Works, Minneapolis, Minn., has awarded contract for the construction of a new foundry to take the place of the one recently burned. This will be twice as large as the old one.

The McGee Switch and Signal Company, Dallas, Texas, recently incorporated, is contemplating the erection of a plant for the manufacture of switches, interlocking devices, etc. Present address is Slaughter building.

The Cleveland (Ohio) Chain and Manufacturing Company, recently incorporated, will erect a plant in Cleveland, it is reported. Capital, $20,000. Incorporators, Louis D. Round, Albert Stanner, David D. Round and others.

The Gschwind Furnace Company, of Youngstown, Ohio, has been incorporated with a capital of $25,000 by Leon Gschwind, Carl K. Gschwind and others. A plant for the manufacture of furnaces will be constructed in Salem.

The Western Tinware Manufacturing Company, St. Louis, Mo., has been incorporated to manufacture sheet metal ware, etc. Capital, $20,000. Incorporators, Frederick Heideman, John. S. Manchester and William F. Heideman.

The Kansas City (Mo.) Lock Nut Company, a new concern, will erect a $15,000 plant. James M. Fitch, of the American Paper Box Company is the promoter of the new company, whose office will be in the Scarritt Building, Kansas City.

Fay Machine Tool Company, Glenwood avenue and Second street, Philadelphia, Penn., has been incorporated. Otto W. Schaum is president, Runmon C. Fay, vice-president and general manager, Wm. H. Rometsch, treasurer and G. W. B. Fletcher, secretary.

On Tuesday, August 6, fire broke out in the japanning room of the Hoggson & Pettis Manufacturing Company, New Haven, Conn. This room was in one corner of the building on the second floor and the fire was confined entirely to that department of the works. The company report that the fire in no way interferes with the manufacture of the Sweetland chuck and that while they are very busy in the chuck department they have lately considerably increased their capacity and are able to make quite prompt deliveries.

Trade Catalogs

American Locomotive Co., New York. Catalog of six wheel type switching locomotives. Illustrated, 62 pages, 6x9 inches, paper.

The Arcade Manufacturing Company, Freeport, Ill. Catalog describing the "Modern" molding machine. Illustrated, 6x9 inches, paper.

Barwood & Snider, The Bourse, Philadelphia, Penn. Circular illustrating and describing the Philadelphia thread milling attachment.

Baldwin Locomotive Works, Philadelphia, Penn. Record No. 62 on balanced compound locomotives. Illustrated, 30 pages, 6x9 inches, paper.

Hitchcock Gas Engine Company, Bridgeport, Conn. Catalog of Hitchcock marine gasolene engine. Illustrated, 24 pages, 6x9 inches, paper.

R. M. Clough, Tolland, Conn. Catalog and price list of gear and milling cutters, reamers and counterbores. Illustrated, 16 pages, 3½x6 inches, paper.

The Electric Controller and Supply Company, Cleveland, Ohio. Bulletin describing universal insulator supports. Illustrated, 16 pages, 3½x6 inches, paper.

The Thomas Wrigley Company, 302 Dearborn street, Chicago, Ill. Catalog of emery wheel dresser, pipe bender, toggle bolts, etc. Illustrated, 16 pages, 3½x6 inches, paper.

Wilder Snow-Plow and Manufacturing Company, Worcester, Mass. Booklet describing radial snow-plow for electric roads. Illustrated, 16 pages, 3½x5½ inches, paper.

The Westinghouse Machine Company, East Pittsburg, Penn. Catalog S-2, No. 7008, describing storage batteries for stationary service. Illustrated, 40 pages, 6x9 inches, paper.

The Linde Air Products Company, Buffalo, N. Y. Circular B descriptive of machinery for producing liquid air, also oxygen and nitrogen. Illustrated, 10 pages, 6x9 inches, paper.

Goodson Electric and Manufacturing Company, 77 Point street, Providence, R. I. Catalog describing Goodson electric ignition system for gas engines. Illustrated, 8 pages, 6x9 inches, paper.

The Veeder Manufacturing Company, Hartford, Conn. Catalog "M" describing counters for use on machines, telephones, voting machines, nickel in slot machines, etc. Illustrated, 12 pages, 3x6 inches, paper.

Independent Pneumatic Tool Company, First National Bank building, Chicago, Ill. Catalog describing "Thor" pneumatic tools and appliances, including air compressors, drills, forges, hammers, etc. Illustrated, 80 pages, 6x9 inches, cloth.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper list free. E.G.Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

We desire a few more machines or specialties to manufacture. Box 423, Troy, N. Y.

Machines designed and built. Walter S. McKinney, M. E., Broadway, Flushing, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Mechanical engineer can act as New York representative for small salary. G. E. Hackett, M. E., 71 Nassau St., New York.

Special machines designed and built: duplicate parts; model or experimental work. Mantle, Park ave. and 129th St., New York.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Men who operate grinding machines should read H. Darbyshire's "Precision Grinding," a $2 book that's worth ten times that money to you. Hill Pub. Co., 505 Pearl St., New York.

Ice machinery wanted; second hand, complete for capacity 15 tons every 24 hours. Address with full particulars and price, F. O. B. Steamer, Brooklyn, Produce Export Co., 87 Tenth Avenue, New York.

A well equipped machine shop and foundry desires to add to its output by the manufacture of articles of brass and iron, which would find a ready sale in the south; correspondence invited. Box 122, AMER. MACH.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Our new up-to-date foundry, just completed, equipped to make high-grade machinery castings; can take care of requirements of machinery builders and guarantee good work at attractive prices. Textile Machine Works, Reading, Pa.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in classroom and by correspondence. The New York School of Automobile Engineers, 146 West 56th Street.

Planer hands—C. Ashley, a planer hand, has written a book "Planer Kinks," for practical planer men and every planer hand should get it; $1 postpaid. Hill Pub. Co., 505 Pearl St., New York.

Salesmen, a paying side-line for you. We will allow a liberal commission for selling a new automatic hose-coupling of exceptional merit which we are placing on the market. This is a rare opportunity to substantially increase your income. Thos. H. Dallett Co., 23d and York, Philadelphia.

Arrange with us to do your manufacturing; we are thoroughly equipped for all classes of machine work, including screw machine and punch parts, tools, jigs, etc.; we also design and build to order special and experimental machinery. Forest City Specialty Manufacturing Co., Rockford, Illinois.

We have a special proposition for a few bright, energetic mechanics, such as foremen, draftsmen or machinists in different sections of the country; no canvassing or selling of any kind, and, while not interfering with your regular work, pays well for the time taken; we want only practical men who can be depended on to give the little time required, each week; further particulars on application. Box 102, AMERICAN MACHINIST.

Manufacturer Wanted—A modern up to date concern in Eastern territory that is equipped for building medium and heavy machinery to take up the building of an established line of machinery amounting to $200,000 or $300,000 gross annually; would have to bear part of office and selling expense; will deal only with principal of first-class concern and will treat same absolutely confidential. Address New York Established Business, Box 315, AMERICAN MACHINIST.

Technically educated, practical inventor and engineer of international reputation, who has received several awards and been decorated by royalty for his productions, is constantly producing new and valuable inventions and processes, embracing electrical, mechanical and chemical lines; furnished all ready for manufacturing; factory installed when desired; wishes to make additional connections with responsible manufacturers to market; references exchanged. Box 318, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Man familiar with drawings, ways of recording them, systems and shop forms and methods, desires position; best references. Box 308, AMERICAN MACHINIST.

Manager, desiring to make a change, solicits correspondence from companies manufacturing interchangeable parts; references and reasons for changing made known to those interested. Box 321, AMER. MACHINIST.

ILLINOIS

Superintendent who can show past results in the handling of men, reduction of costs, and increasing output, wishes to make a change; will consider cash proposition, or cash and a percentage of saving effected. Box 313, AMERICAN MACHINIST.

MASSACHUSETTS

General foreman or superintendent desires change; proven ability to produce results; familiar with high class work and up to date system; young man. Box 323, AM. MACH.

Mechanical superintendent wants position with a firm that requires executive and mechanical ability, can handle any number of men up to 1000; experienced on medium and heavy work, open for engagement Oct. 1; best of references furnished. Box 302, AMERICAN MACHINIST.

MICHIGAN

Automatic screw machine foreman desires change; expert on Brown & Sharpe, Hartford, Acme and Cleveland; good executive and systematizer; designer of tools and cams. Address Box 301, AMER. MACHINIST.

NEW JERSEY

Mechanical draftsman, experienced in special machinery and general engineering wishes a position. Box 305, AMER. MACH.

Draftsman and superintendent's assistant, 29, shop experience, expert in drop forge line, earning $100 per month, wants position at anything with a future. Box 320, AM. M.

Young man, 25 years old, with five years' shop experience, three years as draftsman and one year as checker, desires position with future advancement. Address Box 276, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Address Box 297, AMERICAN MACHINIST.

By technical college graduate, age 25; experience in mechanical drafting and with engineering contractor. Box 316, AM. MACH.

Mechanical engineer, technical graduate familiar with modern factory methods, desires change of position, prefers New York City. Box 280, AMERICAN MACHINIST.

Painter and letterer, 30, wants position as foreman with machinery or construction firm; hustler; knows his work; now with large firm. Box 303, AMERICAN MACHINIST.

Mechanical engineer offers half of his time to concern desirous of increasing output by Taylor system methods of feeds, speeds, tools, belting, lathe, slide rules, etc.; best references. Box 319, AMERICAN MACHINIST.

Superintendent or master mechanic; wide experience; inventive and executive ability; designer of automatic and special machinery on labor-saving tools for interchangeable manufacture; excellent references. Box 304, AMERICAN MACHINIST.

Graduate M. E., shop experience, age 32, designer of high ability; 10 years' experience on fine machinery, typewriters, etc., tools, fixtures, special machinery, at present employed, will accept responsible position; location immaterial. Address Box 260, Auburn, N. Y.

Patternmaker; capable of taking charge of soliciting work; 20 years' experience on all classes of patternmaking, sweep work, green and dry sand a specialty; acquainted with all modern methods where expediency and diminished cost is necessary. Box 306, AM. M.

Experienced, civil and mechanical engineer; age 48; first-class draftsman; 20 years in leading English shops; surveyor, licensed by the British Colonial government; acted assistant superintendent of public works; wants suitable position in or near New York. Address "Surveyor," 614 56th St., Brooklyn.

I am a foreman pattern maker with fourteen years' experience in all classes of pattern work, five years' as foundry assistant superintendent; my determination to advance more rapidly than possible where now located has prompted this inquiry; I feel I can convince you of my executive ability, tact and energy; am thirty years old and greatly desire to connect myself with a good live company, who will give me the opportunity to apply my every effort to their interest and recognize merit when shown. Address Box 257, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Position as advertising manager with manufacturing concern, preferably in mechanical field, by a woman with years of experience in that capacity and field, with large, representative houses; thoroughly competent to handle printing, illustrating and the preparation of copy; at present employed; reasons for seekng change made known to prospective employer. Box 103, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Toolmakers experienced on fixtures, dies and gages. Address with full particulars as to experience, wages required, giving definite time as to commencing work. Ross Rifle Company, Quebec, Canada.

Wanted—Several draftsmen with experience on tools and gages for interchangeable work; address with full particulars as to experience, wages required, giving definite time as to commencing work. Ross Rifle Co., Quebec, Canada.

CONNECTICUT

Wanted—First-class all-around machinist for new and general repair work. The New Machine Co., Danbury, Conn.

ILLINOIS

A young and growing concern wishes to engage, as designer on automatic machinery, a man whose experience covers from five to ten years on first-class work; no attention will be paid to applicants who do not give complete particulars as to age, experience, references and salary expected. Box 314, AMERICAN MACHINIST.

INDIANA

Wanted—Five good toolmakers and six lathe men; good wages; steady employment. The Western Motor Co., Logansport, Ind.

IOWA

Wanted—Mechanical draftsman; must have large experience in hoisting engines and mine equipment; give age, experience, salary wanted and references in first letter; permanent employment to right man. Ottumwa Iron Works, Ottumwa, Iowa.

MISSOURI

Wanted—Foreman of experience for general machine shop; must have executive ability and be able to make machinery and operators work at maximum efficiency. Write fully giving age, experience and wages wanted. Box 311, AMERICAN MACHINIST.

NEW JERSEY

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Master mechanic for a machine shop with a well established business; a young educated, experienced and thoroughly up to date man; only those who state age, nationality, experience, references, salary expected, etc., with full particulars will be considered; growing business and an opportunity for the right man. Box 309, AMERICAN MACHINIST.

NEW YORK

Wanted—First-class toolmakers on tools, jigs and fixtures. Boxes 7 and 8, Syracuse, N. Y.

Wanted—First-class wood patternmaker; permanent work and good wages. Address Clark Bros. Co., Belmont, N. Y.

Wanted—Toolmakers experienced on metal patterns, automatic machine work, etc.; state age, wages, experience and references. Box 322, AMERICAN MACHINIST.

Wanted—A highly skilled lathe operator, trained on lathes from 20 to 60 in. swing; an extraordinary producer of good work only need apply; big wages to the right man. Address Clark Bros. Co., Belmont, N. Y.

Wanted—Punch pressman on sub-die and open-die work, to take charge of press department; good steady position for the right man; state experience and salary wanted. Address Box 299, AMERICAN MACHINIST.

A large manufacturing concern, in the machinery line, wishes to employ a first-class writer of business circular; booklet and newspaper advertising; permanent position and good salary to the right man. Box 312, AMERICAN MACHINIST.

Wanted—A first-class automobile repair man; one with executive ability and push, to take charge of repair department with one of the largest automobile factories in the East; only competent men who are holding similar positions need apply. Address "Auto," Box 286, AMERICAN MACHINIST.

Wanted—Energetic salesman by large house for special lines of machine tools and tools; must be well connected with the trade and be able to build up very promising business; practical knowledge of machine tools essential; only those having traveled for machine tool concerns need apply; state age, experience, references, salary desired; all information confidential. Box 317, AMER. MACH.

Wanted—General foreman for machine shop employing 75 to 100 men, building machine tools, special machinery, etc.; must be thorough mechanic, with tact, resource and push; capable and familiar with handling men and work to best advantage; good opportunity and future for competent man, with rapidly growing business. Address with full particulars as to experience, age, references, etc. Box 256, AMERICAN MACHINIST.

Machinists for lathes, planers and floor work wanted; day and night shift; we are increasing our force and offer here an excellent opportunity for energetic mechanics who have determination to forge ahead; the future advancement of all our employees depends entirely upon their capabilities and energy; we recognize merit as fast as the opportunity offers; when applying state wages desired. Appy Ingersoll-Rand Co., Painted Post, N. Y.

OHIO

Wanted—First-class man capable of putting in premium or piece work system in automobile shop; state experience and salary expected. Box 300, AMERICAN MACHINIST.

Wanted—Foreman to take charge of shop in Ohio, employing fifty men; must have experience in the manufacture of wood-working machinery; state age, experience, reference and salary. Address Wood, Box 279, AM. M.

Wanted—Foreman, experienced in drafting, designing and making dies and tools for metal specialties and special machinery; state age, experience, references and salary; splendid opportunity for advancement to right man. Box 324, Cincinnati, Ohio.

PENNSYLVANIA

Wanted—Foreman for gear cutting department; must have experience; apply with particulars to R. D. Nuttall Co., Pittsburg, Pa.

On account of increased business we are constantly in need of high-grade planer, lathe, and boring mill hands; also competent erectors, no labor troubles. The Blaisdell Machinery Co., Bradford, Pa.

We are just completing the fitting up of a modern machine manufacturing plant, and invite applications for employment from machinists, pattern makers and molders; steady employment and good wages for reliable and desirable workmen; when writing give full details of experience. The Shepherd Engineering Co., Williamsport, Pa.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery; good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

VIRGINIA

Wanted—Two or three first-class draftsmen, those familiar with steam shovel and dredge designs preferred; give full experience and salary expected. Box 882, Richmond, Va.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Gas engine, 10 horse power, perfect condition. The Young & Bennett Co., Springfield, Ohio.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, O.

One new No. 2 plain automatic feed Cincinnati miller, with oil pump and tank, and No. 3 plain vise. Immediate delivery. Box 310, AMERICAN MACHINIST.

For Sale—Ten volume library covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

One 10x10x12 duplex steam pump; one 10x14x12 Rand air compressor; one No. 3 Toledo punch press; two hydraulic presses, will take in material 35"x35". Shartle Brothers, Middletown, O.

For sale, outright or on royalty; a very profitable machine manufacturing business, on well patented machine, having great demand; owner going to Europe; exceptional chance for larger concern. Box 307, AMER. MACH.

For Sale—Set of patterns for pulley turning and boring lathe, sizes 30", 42" and 60" with detail working drawing, and with some special boring bars and tools; these patterns were originally purchased from M. C. Hendley, Indianapolis, Ind.; a bargain for anyone who wishes to take up this line of goods to manufacture them; price $3000. Goldens' Foundry & Machine Co., Columbus, Ga.

Alphabetical Index to Advertisers

	PAGE
Abrasive Material Co.	76
Acme Machinery Co.	38
Adams Co.	102
Albro-Clem Elevator Co.	87
Almond Mfg. Co., T. R.	82
Alteneder & Sons, Theo.	38
American Emery Wheel Wks.	76
American Gas Furnace Co.	25
American Pulley Co.	68
American Tool Works Co. 8 and	96
American Tube & Stamp'g Co.	99
Armstrong-Blum Mfg. Co.	94
Armstrong Bros. Tool Co.	64
Athol Machine Co.	81
Automatic Machine Co.	94
Backus Water Motor Co.	77
Baird Machine Co.	80
Baker Bros.	66
Baldwin Chain & Mfg. Co.	72
Baldwin Steel Co.	47
Barnes Co., B. F.	76
Barnes Co., W. F. & John.	14
Barnett Co., G. & H. 4th cover	
Bartlett, E. E.	64
Baush Mach. Tool Co. 3d cover	
Bay State Stamping Co.	101
Beaman & Smith Co. 15 and	82
Beche & Gross	95
Becker-Brainard Milling Machine Co.	23
Bemis & Call Hardw. & Tool Co.	94
Besly & Co., Chas. H.	62
Bethlehem Steel Co.	51
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	72
Bilgram, Hugo	38
Billings & Spencer Co.	67
Binsse Mach. Co.	38
Birdsboro Steel Fdry. & Machine Co.	62
Blaisdell Machinery Co.	84
Blanchard Machine Co.	68
Bliss Co., E. W.	25
Blount Co., J. G.	32
Boker & Co., Hermann	59
Boston Gear Works	86
Box & Co., Alfred	92
Boynton & Plummer	92
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	68
Bridgeport Safety Emery Wheel Co.	76
Bristol Co. 4th cover	
Bristol, Wm. H.	38
Brown & Co., R. H.	83
Brown Hoisting Machry. Co.	93
Brown & Sharpe Mfg. Co. 45 and 4th cover	
Brubaker & Bros., W. L.	94
Buffalo Forge Co. 4th cover	
Bullard Mach. Tool Co. 37 and	96
Burke Electric Co.	90
Burke Machinery Co., The	70
Burroughs Co., Chas.	71
Butterfield & Co.	62
Caldwell & Son Co., H. W.	70
Carborundum Co.	20
Card Mfg. Co., S. W.	16
Carpenter Tap & Die Co., J. M.	95
Carver File Co.	72
Case Mfg. Co.	92
C & C Electric Co.	88
Chambersburg Engineering Co.	69
Champion Tool Works Co.	72
Chicago Flexible Shaft Co.	67
Chicago Pneu. Tool Co.	84
Chicago Rawhide Mfg. Co.	87
Cincinnati Machine Tool Co.	21
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	102
Clark Auto. Telephone Switchboard Co.	94
Clark Cast Steel Cement Co.	80
Clark, Jr. & Co., Jas.	21
Clayton Air Compressor Wks.	84
Cleveland Auto. Mach. Co.	18
Cleveland Cap Screw Co.	73
Cleveland Crane & Car Co.	92
Cleveland Planer Works	95
Cleveland Twist Drill Co. 4th cover	
Cleveland Wire Spring Co.	99
Clough, R. M.	73
Coates Clipper Mfg. Co.	71
Coes Wrench Co.	27
Colburn Machine Tool Co.	25
Cook Co., Asa S.	72
Cowanesque Valley Iron Wks.	74
Crescent Forgings Co.	67
Crocker-Wheeler Co.	88
Crosby Steam Gage & Valve Co.	17
Cumberland Steel Co.	73
Curtis & Co. Mfg. Co.	85
Curtis & Curtis Co.	72
Cushman Chuck Co.	82
Dallett Co., Thos. H.	66
Davis, Rodney	87
Desmond-Stephan Mfg. Co.	76
Detrick & Harvey Mach. Co.	70
Diamond Chain & Mfg. Co.	73
Diamond Saw & Stamping Works	95
Diehl Mfg. Co.	90
Dill Slotter People	71
Dixon Crucible Co., Joseph	77
Dodge & Day	73
Dreses Machine Tool Co.	47
Drucklieb, C.	84
Earle Gear & Mach. Co.	87
Eastern Machinery Co.	92
Eberhardt Bros. Mach. Co.	87
Electric Controller & Supply Co.	89
Elmes Engineering Works, Chas. F.	72
Emmert Mfg. Co.	81
Errington, F. A.	83
Evans Friction Cone Co.	72
Excelsior Needle Co.	80
Fairbanks Co.	70
Farrel Fdry. & Mach. Co.	80
Fawcus Machine Co.	86
Fellows Gear Shaper Co.	87
Firth-Sterling Steel Co.	79
Fitchburg Machine Works	31
Foote-Burt Co., The	101
Fosdick Machine Tool Co.	16
Franklin Mfg. Co., H. H.	99
Frevert Machinery Co.	95
Gang Co., Wm. E.	95
Gardner Machine Co.	76
General Electric Co.	88
General Pneumatic Tool Co.	93
Geometric Tool Co.	21
Gisholt Mach. Co. 20 and	101
Gleason Works. 4th cover	
Globe Machine & Stamping Co.	80
Goldschmidt Thermit Co.	80
Goodell-Pratt Co.	101
Gorton Machine Co., Geo.	74
Gould & Eberhardt	67
Graham Mfg. Co.	81
Grant Gear Works	86
Grant Mfg. & Mach. Co.	71
Gray Co., G. A.	38
Gray & Prior Machine Co.	84
Greaves, Klusman & Co.	69
Hammacher, Schlemmer & Co.	51
Hanna Engineering Works	94
Hardinge Bros.	73
Harrington, Son & Co., Edw.	92
Harrison & Knight Mfg.Co.	72
Hart & Cooley Co.	24
Hart Mfg. Co., The	82
Heald Machine Co.	100
Hendey Machine Co.	53
Henley Publishing Co., N. W.	25
Henry & Wright Mfg. Co.	65
Hill, Clarke & Co., Inc.	97
Hill Publishing Co. 38 and	60
Hisey-Wolf Machine Co.	26
Hoefer Mfg. Co.	17
Hoggson & Pettis Mfg. Co.	83
Hopkinson Machine Works	81
Horsburgh & Scott Co. 4th cover	
Horton & Son Co., E.	82
Hunt & Co., Robt. W.	73
Hurlbut-Rogers Machine Co.	92
Hyatt Roller Bearing Co.	72
Independent Pneumatic Tool Co.	73
Industrial Oxygen Co.	80
Ingersoll-Rand Co.	85
Ingersoll Milling Mach. Co.	68
International Specialty Co.	76
Jacobs Mfg. Co.	83
Jacobson Mach. Mfg. Co.	77
Jantz & Leist Electric Co.	90
Jenkins Brothers	77
Johnson Mach. Co., Carlyle	66
Jones & Lamson Mach. Co. 12, 13 and	38
Kelly Co., R. A.	95
Kempsmith Mfg. Co.	22
Kent & Co., Edwin R.	80
Kern Machine Tool Co.	24
Keuffel & Esser Co.	98
Keyless Lock Co.	72
Keystone Steel Casting Co.	78
Keystone Watch Case Co.	96
Kilbourne & Jacobs Mfg. Co., The	73
Kinsey Co., The E. A.	98
Landis Machine Co.	69
Landis Tool Co.	1
Lapointe Machine Tool Co.	82
Lea Equipment Co.	26
Le Blond Machine Tool Co. R. K. 4th cover	
LeCount, Wm. G.	82
Lincoln Motor Works Co.	90
Link-Belt Co.	63
Lodge & Shipley Machine Tool Co.	4
Long & Allstatter Co.	69
Lucas Machine Tool Co.	100
Lumen Bearing Co.	78
Lunkenheimer Co., The	77
Lyon Metallic Mfg. Co.	26
Macdonald & Macdonald	72
Main Belting Co.	101
Mfg. Equip. & Eng. Co.	32
Manufacturers Foundry Co.	78
Maris Brothers	92
Marshall & Huschart Machinery Co.	97
Mass. Saw Works	30
McCabe, J. J. 65 and	96
McDowell, Stocker & Co.	60
McLeod & Henry Co.	75
Merritt & Co.	73
Merritt, Jos.	80
Milton Mfg. Co.	57
Miner & Peck Mfg. Co.	94
Moore Co., Franklin	93
Morris Fdry. Co., Jno. B.	27
Morse Chain Co.	64
Morse Twist Drill & Machine Co.	49
Morton Mfg. Co.	94
Mossberg Wrench Co.	94
Motch & Merryweather Machinery Co.	97
Mueller Mach. Tool Co.	69
Nash Co., Geo.	74
National-Acme Mfg. Co.	102
National Machinery Co.	73
New Britain Machine Co.	99
New Haven Mfg. Co.	69
New Process Rawhide Co.	87
Newton Machine Tool Works	11
Nicholls, W. S.	92
Nicholson File Co.	17
Nicholson & Co., W. H.	70
Niles-Bement-Pond Co. 33, 34, 35, 36 and	98
Nolte Brass Co.	80
Northern Electrical Mfg. Co.	89
Northern Engineering Works	92
Norton Co.	61
Norton Grinding Co.	30
Nuttall Co., R. D.	86
Nutter, Barnes & Co.	69
Obermayer Co., The S.	68
Oesterlein Machine Co.	94
O. K. Tool Holder Co.	61
Olds Gas Power Co.	77
Owen Machine Tool Co.	22
Page-Storms Drop Forge Co.	94
Parker Co., Chas.	81
Patterson, Gottfried & Hunter, Ltd.	71
Pawling & Harnischfeger	92
Paxson Co., J. W.	84
Philadelphia Bourse	70
Philadelphia Gear Works	86
Phosphor Bronze Smelting Co.	78
Pike Mfg. Co.	57
Pittsburg Automatic Vise & Tool Co.	81
Poole Co., J. Morton	68
Potter & Johnston Mach. Co.	53
Pratt Chuck Co.	82
Pratt & Whitney Co. 2 and	3
Prentice Bros. Co.	29
Prentiss Tool & Supply Co.	96
Queen City Mach. Tool Co.	73
Rahn-Carpenter Co.	95
Ransom Mfg. Co.	76
Reed Mfg. Co.	81
Reichhelm & Co., E. P. 4th cover	
Reinforced Brazing & Mach. Co.	78
Ridgway Dynamo & Engine Co.	90
Rivett-Dock Company. 3d cover	
Rivett Lathe Mfg. Co. 3d cover	
Rockford Machine Tool Co.	87
Rock Island Tool Co.	81
Rockwood Mfg. Co.	93
Rogers Works, John M.	61
Rogers & Hubbard Co.	78
Roth Bros. & Co.	90
Rowell Co., W. G.	80
Royersford Foundry & Machine Co.	72
Safety Emery Wheel Co.	76
Sampson Co., Geo. H.	85
Saunders Sons, D.	74
Saunders Co., Jas.	62
Sawyer Gear Works	86
Schieren & Co., Chas. A.	94
Schumacher & Boye	9
Scranton & Co., The	80
Sebastian Lathe Co.	65
Sellers & Co., Wm.	28
Seneca Falls Mfg. Co.	64
Shultz Belting Co.	94
Sibley Machine Tool Co.	68
Skinner Chuck Co.	82
Skinner Shipbuilding & Dry Dock Co.	72
Slate Machine Co., Dwight	71
Sloan & Chace Mfg. Co.	14
Slocomb Co., J. T.	75
Smith Countershaft Co.	31
Smith Fdry. Supply Co., J. D.	80
Smith & Mills	94
Soltmann, E. G.	98
Spacke Machine Co., F. W.	84
Spicer Universal Joint Mfg. Co.	73
Sprague Electric Co.	91
Springfield Machine Tool Co.	15
St. Mary's Machine Co.	77
Standard Connecting Rod Co.	77
Standard Engineering Works	73
Standard Gauge Steel Co.	71
Standard Tool Co.	24
Standard Welding Co., The	63
Stark Tool Co.	90
Starrett Co., L. S.	59
Steptoe Shaper Co., John	81
Straley & Hasbrouck	72
Struthers-Wells Co.	77
Sturtevant Co., B. F.	26
Tabor Mfg. Co.	68
Tate, Jones & Co.	99
Taylor & Fenn Co.	70
Taylor-Wilson Mfg. Co.	86
Toomey, Frank	96
Triumph Electric Co.	90
Trump Bros. Machine Co.	82
Turner Brass Works	72
Turner Mach. Co.	69
Union Twist Drill Co.	55
United Engineering & Fdry. Co.	75
U. S. Electrical Tool Co.	75
Van Dorn & Dutton Co.	86
Vandyck Churchill Co.	24
Vitrified Wheel Co.	76
Von Wyck Machine Tool Co.	95
Wagner Electric Mfg. Co.	90
Walcott & Wood Machine Tool Co.	73
Waltham Machine Wks.	73
Waltham Watch Tool Co.	61
Ward & Sons, Edgar T.	79
Warner Instrument Co.	70
Warner & Swasey Co.	100
Waterbury Farrel Fdry. & Mach. Co.	71
Watson-Stillman Co.	65
Wells Bros. Co.	74
West Haven Mfg. Co. 4th cover	
Westinghouse Elec. & Mfg. Co.	89
Westmacott Gas Furnace Co.	80
Weston Elec. Instrument Co.	92
Whitcomb-Blaisdell Machine Tool Co.	19
Whitman & Barnes Mfg. Co.	66
Whitney Mfg. Co.	43
Whiton Machine Co., D. E.	82
Wiley & Russell Mfg. Co.	95
Williams, Brown & Earle	96
Williamson Vise Co.	95
Wilmarth & Morman Co.	76
Windsor Machine Co.	84
Wood's Sons Co., T. B.	93
Woodward & Powell Planer Co.	95
Worcester Machine Screw Co.	94
Wormer Machinery Co., C. C.	97
Wyman & Gordon Co. 4th cover	
Yale & Towne Mfg. Co.	93

Classified Index to Articles Advertised

Abrasive Materials

Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Cortland Cor. Wheel Co., Cortland, N. Y.
Norton Co., Worcester, Mass.
Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Globe Machine & Stamping Co., Cleveland, O.
Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Butterfield & Co., Derby Line, Vt.
Cochrane-Bly Co., Rochester, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arches, Boiler Door

McLeod & Henry Co., Troy, N. Y.

Architects

Dodge & Day, Philadelphia, Pa.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, O.
Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling

Baird Machine Co., Oakville, Ct.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller

Boston Gear Works, Norfolk Downs, Mass.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

Belt Dressing

Cling-Surface Mfg. Co., Buffalo, N. Y.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Rhoads & Sons, J. E., Phila., Pa.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Rhoads & Sons, J. E, Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belting, Leather

Main Belting Co., Phila., Pa.
Rhoads & Sons, J. E., Phila., Pa.
Schieren & Co., Chas. A., New York.

Belting, Leather—*Continued.*

Shultz Belting Co, St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Benches, Work

Manufacturing Equipment & Engineering Co., Boston, Mass.

Bending Machinery, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machinery, Plate

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machinery, Power

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blanks, Nut and Screw

Dyson & Sons, Jos., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blowers

American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.
Keuffel & Esser Co., New York.
Soltmann, E. G., New York.

Blue Print Paper

Keuffel & Esser Co., New York.
Soltmann, E. G., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Boiler Setting

McLeod & Henry Co., Troy, N. Y.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd, John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., East Hampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads

Lang Co., G. R., Meadville, Pa.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, Ohio.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Middletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Boxes, Tote

Cleveland Wire Spring Co., Cleveland, Ohio.
Lyon Metallic Mfg. Co., Aurora, Ill.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Brazing

Reinforced Brazing & Machine Co., Pittsburg, Pa.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum

See Grinding Wheels

Case-Hardening

Rogers & Hubbard Co., Middletown, Conn.

Cast Iron Brazing

Reinforced Brazing & Mach. Co., Pittsburg, Pa.

Castings, Brass and Bronze

Lumen Bearing Co., Buffalo, N. Y.
Rowell Co., W. G., Bridgeport, Ct.

Castings, Die Molded

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Keystone Steel Casting Co., Chester, Pa.
Manufacturers Foundry Co., Waterbury, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel

Bethlehem Steel Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.
Keystone Steel Casting Co., Chester, Pa.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.

Centering Machines—*Cont.*
Hill, Clarke & Co., Inc., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Bartlett, E. E., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor, Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Bartlett, E E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.

Circuit Breakers—*Continued.*
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cowanesque Valley Iron Wks., Cowanesque, Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Woods Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic
Sturtevant Co., B. F., Hyde Park, Mass.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jefsey City, N. J.

Compound, Slushing
Warren Bros. Co., Boston, Mass.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Cambridge, Mass.
Iroquois Machine Co., Providence, R. I.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.

Controllers and Starters, Electric Motor—*Continued.*
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic
Link-Belt Co., Philadelphia, Pa.

Coping Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum
See Grinding Wheels.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S, Athol, Mass

Counters, Machinery
Veeder Mfg. Co., Hartford, Ct.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes
Box & Co., Alfred, Phila., Pa.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co., Mfg. Co., St. Louis, Mo.
Frevert Machinery Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.

Cranes—*Continued.*
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co, New York.
Underwood & Co., H. B., Phila., Pa.

Crank Shafts
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

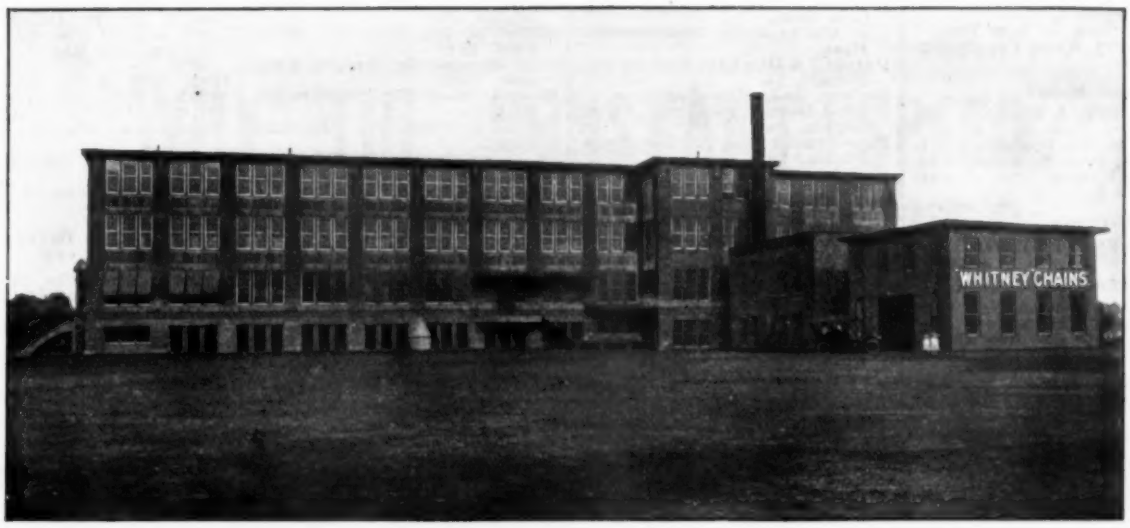
Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach Co., Hyde Park, Mass.
Boker & Co., Hermann, New York
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.

NEW FIREPROOF FACTORY

NEW MACHINERY AND IMPROVED METHODS



High Grade Driving Chains
Keys and Cutters for the Woodruff Patent System of Keying
Hand and Key-seat Milling Machines

Our Hand Milling Machine cuts Key-ways automatically for the Woodruff Patent System of Keying and is also desirable for profiling, cam cutting, gear cutting, etc., as well as all regular hand milling operations

THE WHITNEY MFG. COMPANY

HARTFORD, CONN.

Cutting-off Tools—*Continued.*
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Cyclometers
Veeder Mfg. Co., Hartford, Ct.

Diamond, Tools
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.
Safety Emery Wheel Co., Springfield, Ohio.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

Drawing Materials
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittintineague, Mass.
Noyes Mfg. Co., Waynesboro, Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Slate Mach. Co., Dwight, Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks, Co., Cin. O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Dallett Co., Thos. H., Phila., Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric
Chicago Pneumatic Tool Co., Chicago, Ill.
Dallett Co., Thos. H., Phila. Pa.
Independent Pneumatic Tool Co. Chicago, Ill.

Drilling Machines, Multiple Spindle
American Tool Wks Co., Cin. O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.

Drilling Machines, Multiple Spindle—*Continued.*
Barnes Co., W. F. & John, Rockford, Ill
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York. delphia, Pa.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Mach. Co., Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co, Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canadn.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros., Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, Ohio.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.

Drilling Machines, Upright—*Continued.*
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Coates Clipper Mfg. Co., Worcester, Mass.
Cincinnati Electrical Tool Co., Cincinnati, O.
Dallett Co., Thos., H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Clayton Air Compressor Works, New York.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hisey-Wolf Mach. Co., Cin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co. Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder
Graham Mfg. Co., Providence, R. I.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Eectric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.

Dynamos—*Continued.*
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Clark, Jr. & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Weston Elec. Instrument Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr. & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Lincoln Motor Wks. Co., Cleveland, O.
Ransom Mfg. Co., Oshkosh, Wis.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room
Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Engineers, Mechanical and Electrical
Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Philadelphia, Pa.
Merritt, Jos., Hartford, Conn.

Engines, Gas and Gasolene
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa

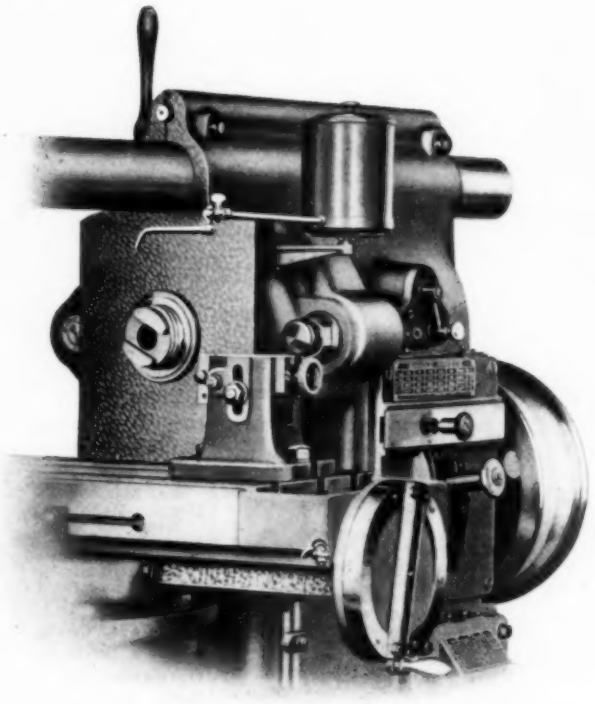
Brown & Sharpe Mfg. Co.,

Providence, R. I., U. S. A.

WHY THE CONSTANT SPEED DRIVE MILLING MACHINE?

In order that an unvariable power for any given diameter of cutter on any spindle speed can be available.

How Then Can This Power Be Obtained?



By means of a wide belt running at a high constant speed over a machine pulley of large diameter and a countershaft pulley of equal diameter. This gives large belt contact and high belt velocity, the *two requisites of Power.*

Additional Advantages

No belts to shift. All changes of spindle speed made at the side of the machine by the simple adjustment of index slide and lever. Feeds independent of spindle speeds.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.

Engines, Steam

American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.

Fans, Electric

Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps

American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
Heller Bros. Co., Newark, N. J.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filing Machines

Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Fire Brick

McLeod & Henry Co., Troy, N. Y.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Machy. Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forging Machinery

Scranton Co., The, New Haven, Conn.

Forgings, Drop

Bethlehem Steel Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic

Bethlehem Steel Co., So. Bethlehem, Pa.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Machine

Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel

Baldwin Steel Co., New York.
Bethlehem Steel Co., So. Bethlehem, Pa.
Crescent Forgings Co., Oakmont, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Goldschmidt Thermit Co., New York.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers

Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Enameling

American Gas Furnace Co., New York.

Furnaces, Gas

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Obermayer Co., S. Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Oil

Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop

Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

Gages, Standard—*Continued.*

Rogers Wks., Jno. M., Gloucester, City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam

Crosby Steam Gage & Valve Co., Boston, Mass.
Williams Valve Co., D. T., Cincinnati, Ohio.

Gas Blowers and Exhausters

Sturtevant Co., B. F., Hyde Park, Mass.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waterbury Gear Co., Waterbury, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Iroquois Machine Co., Providence, R. I.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waterbury Gear Co., Waterbury, Conn.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.

Gears, Molded—*Continued.*

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co. McKees Rocks Pa.

Gears, Rawhide

Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear Mach. Co., Phila., Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Safety Emery Wheel Co., Springfield, Ohio.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Mueller Machine Tool Co., Cincinnati, Ohio.
Niles-Bement Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Bath Grinder Co., Fitchburg, Mass.
Becker Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.

Graphic and Other Aids in Designing

The Use of Drawings and Samples of Various Machine Parts to Aid Draftsmen in Determining Sizes, Etc., of Component Parts of Machines

BY LUTHER D. BURLINGAME*

There are many simple devices that are a direct help to the judgment in drafting-room work and, while those here described are more particularly for the use of persons of limited experience who are not fully familiar with reading drawings, there are times when the most experienced can get help from their use. For example, when selecting a spiral spring for a given purpose, there is usually a vague idea as to the amount of pressure that can be obtained from a given diameter of wire, diameter of coil and other variable conditions, resulting in a guess wide of the mark when trying to determine beforehand what proportions to use.

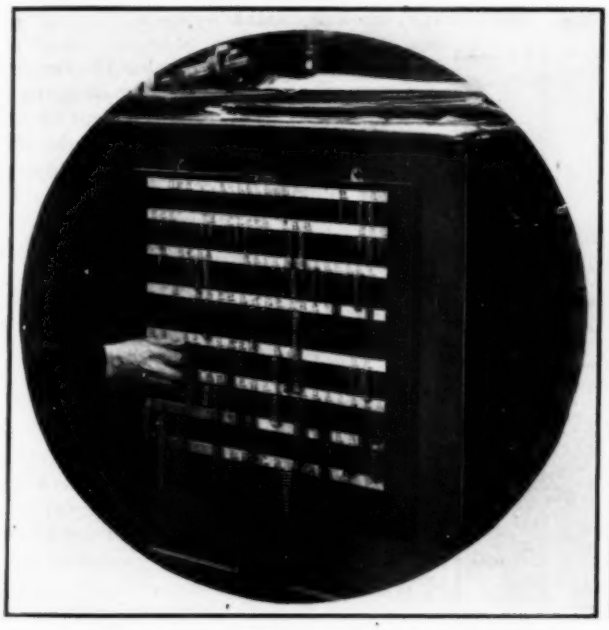


FIG. 1. SAMPLES OF SPIRAL SPRINGS

FIG. 2. SAMPLES OF ROUND SIZES

In the drafting department of the Brown & Sharpe Manufacturing Company a board to which are wired sample spiral springs selected from the large number of sizes kept in stock is hung in a convenient place. These are so mounted that the draftsman can apply pressure to any sample on the board by the thumb and finger, or by other means, and at once get a fair conception of which spring is best suited to a particular use. These springs are part of a comprehensive system of stock parts such as screws, studs, knobs, nuts, washers, etc., for general use on machines and tools built by this company.

Another aid to the judgment is to have for reference a set of hardwood cylindrical plugs from about ⅜ inch in diameter up to 3 inches in diameter, or larger if the requirements warrant, varying by 1/16 inch between the smaller sizes and by 1/8 inch between the larger. Sizes smaller than ⅜ inch are better made of steel rods and wire, and nickel-plated so that they can be handled without rusting. These plugs are useful as an aid to the judgment in determining sizes. In ordinary machine and tool designing a better idea can usually be had of what is required by seeing and feeling the actual size in bulk than by calculation. Differences of opinion, especially when those outside of the drafting force are parties to the discussion, can often be quickly settled by reference to such plugs. When there is a question as to how much of a shoulder should be provided to give sufficient surface for a given end thrust, the putting of two plugs together, end to end, shows at a glance how much there will be and aids the judgment in determining whether it is ample.

A strip of wood graduated to about 10 feet from the floor and attached to a column or to the wall in the drafting room has other uses besides measuring to see who is the tallest draftsman, or how much the errand boy has grown in a year. Such a scale can be used to determine the most convenient hight for the table carrying the work on a given machine, to see at what hight the spindle should be from the floor to be most satisfactory or to determine the proper hights for levers or other operating parts; in fact, for any purpose where hights are to be determined.

Another aid to the draftsman is to have a set of the standard wrenches located in a rack at some convenient point in the drafting room, thus giving an opportunity to take a wrench in the hand and test the pressure obtained with a given length of handle, so that the proper selection may be made, limiting the wrench to just what is required for the adjustment of delicate parts. Furthermore, it is convenient at times to lay the wrench on the drawing and, by swinging the handle, see if in a close place it can swing far enough to make the adjustment. The jaws of the wrenches are usually made at an angle of 15 degrees with the handle, thus making it possible, when adjusting a hexagonal head or nut, to adjust it even when only one-twelfth of a turn can be made at a time. This is accomplished by reversing the wrench after each movement.

A set of standard handles gives opportunity to see how each size looks and feels in the hand as a guide for suitable selection. A set of ball cranks, so proportioned that the two ends will balance, shows the sizes carried in stock ready for use. There is a drawing of the handles, full size, half size and quarter size, with centers of the radii located to aid the draftsman in laying them out correctly and quickly on his drawings to any of these scales. There

*Chief draftsman, the Brown & Sharpe Manufacturing Company.

is also a set of templets which can be laid on the paper and marked around, saving time both in penciling and inking. Besides, there is a set of negative templets for use in the pattern shop. This is a guide to the patternmaker when making patterns for levers or other parts having handles. Formers and formed tools of these same shapes are kept on hand to use in lathes and screw machines for producing the required sizes of handle, thus insuring uniformity throughout the works.

Standards for nurls have been adopted by the Brown & Sharpe Manufacturing Company for the varied requirements. To indicate to the eye and to the hand how the different grades of diamond nurls look and feel, samples in the form of paper weights are in use, having each grade of nurl rolled on a diameter proportioned to the degree of coarseness suited to actual use.

The use of a large blackboard to show machines full size has often been recommended as a means of getting a correct impression of the size (massiveness) of

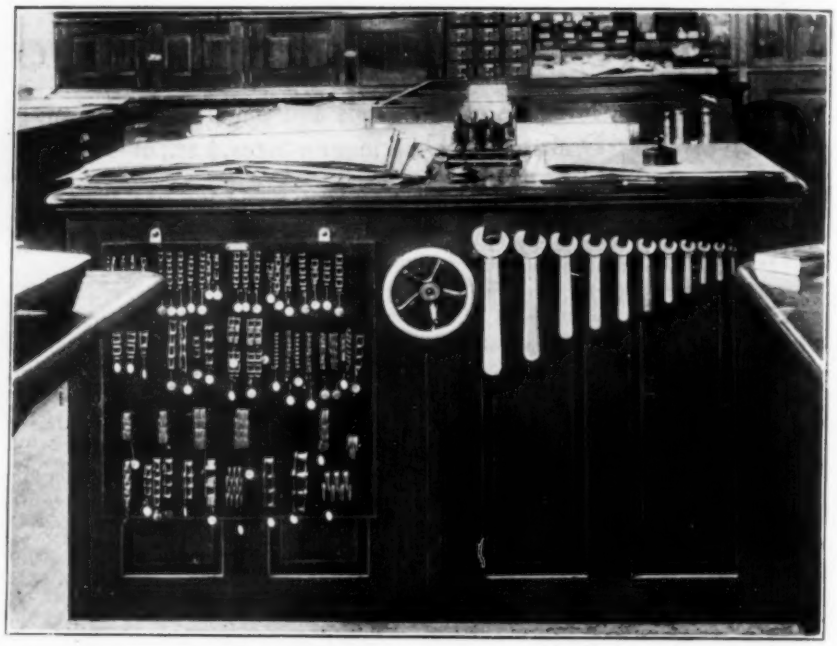


FIG. 4. SAMPLE WRENCHES AND CHAINS

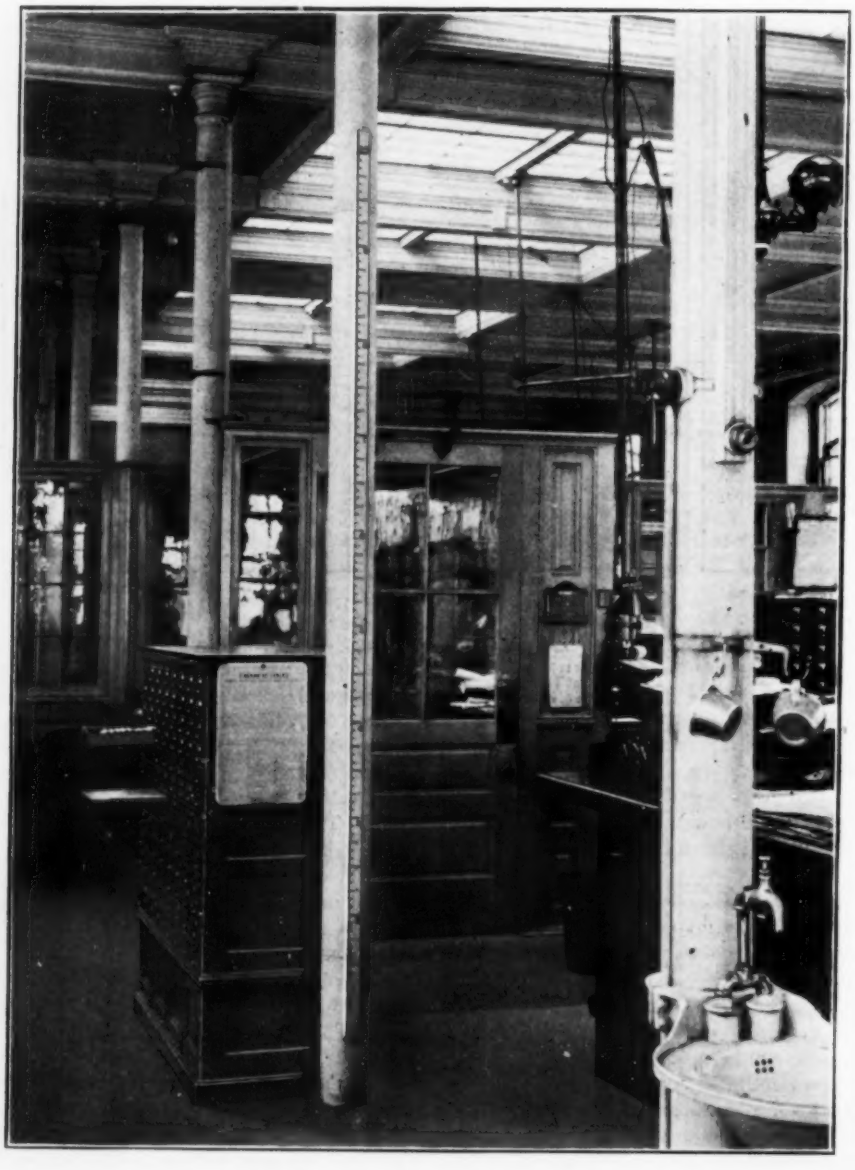


FIG. 3. A VERTICAL MEASURING ROD

a machine and to determine the convenience of position for operating hand wheels, levers, etc. An argument for using this method is that those of the officials who want to have a general idea of a new machine to be built before the work proceeds can get a much better conception by seeing it outlined full size on a blackboard in heavy chalk lines than by seeing small-size layouts and disconnected details. While this advantage probably exists to some extent, I think that even such a drawing is misleading, as it does not give a proper idea of depth or mass and thus falls far short of producing in the mind a real conception of the proportions of the finished machine. I never knew experienced draftsmen who believed that they received much help from such blackboard sketches. The experienced mechanical draftsman has his judgment and sense of proportion so developed that he seldom needs auxiliary aid, even when laying out work on a reduced scale.

An instance of the help received by the use of graphic methods is shown in the use of a system for indexing photographic negatives. The index card is large and includes not only information usually written on such a card but also a blue print from the negative, showing to the eye instantly what each particular negative number stands for. Where there are a number of views of a machine, this is a direct aid in getting the one wanted.

Some of the helps here described are, as has been suggested, more for the beginner than for the experienced draftsman. They aid, however, to develop judgment and are factors in making an apprenticeship system in a drafting room a success. I have often heard managers and chief draftsmen say that they have found inexperienced help in the drafting room more trouble than it is worth, and for that reason they do not employ such

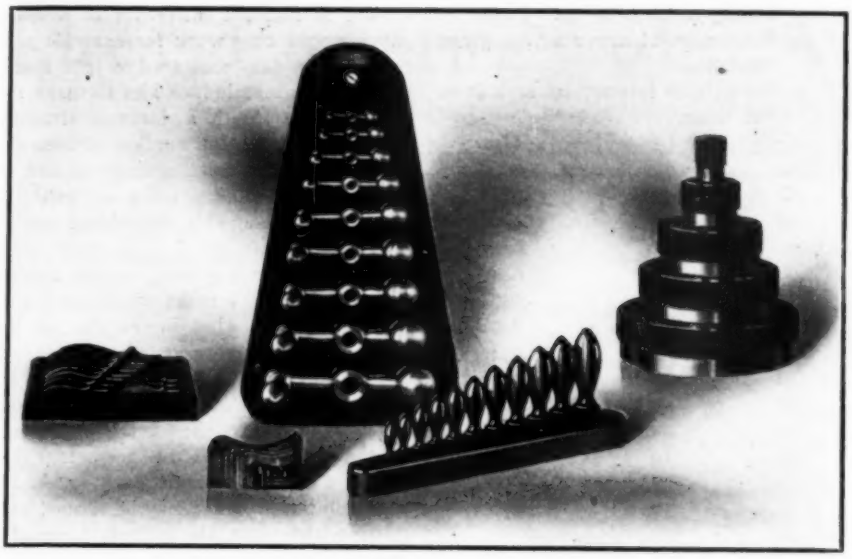


FIG. 5. SAMPLE HANDLES AND NURLING

help. It is probable that in places where such a feeling prevails, there is little system, or organized effort to make past experience available; that in such places there is no attempt to so train young men by furnishing aids to the development of their judgment as to make efficient workers out of inexperienced help.

Turning to the half-tone illustrations, Fig. 1 shows a spiral-spring sample board and Fig. 2 a drawer of round standards. In each case the manual investigation of a part is shown. Books giving complete dimensions of the springs are in the hands of each draftsman.

In Fig. 3 can be seen a 10-foot graduated rod fastened to a drafting-room column. A card index case and some other details of the equipment of the room may be seen.

A set of standard wrenches, a sample board of chains, a sample hand wheel and other details of equipment show in Fig. 4. The samples of machine handles and their templets, sample ball cranks and sample standard nurlings, to which I have referred, are shown by Fig. 5. Fig. 6 shows a photograph index drawer.

Method of Piecing out Work Through Department Foremen

By C. L. G

I have charge of one of the departments in the factory of one of the most prominent of machine-tool builders. The foremen of this factory are given an excellent opportunity of increasing their remuneration as the work is given out to them under a plan similar to the Halsey system. The foremen are in turn expected to carefully piece out the work to their men.

In the year 1902, at my personal request, instructions were given to the premium department to base my remuneration on a

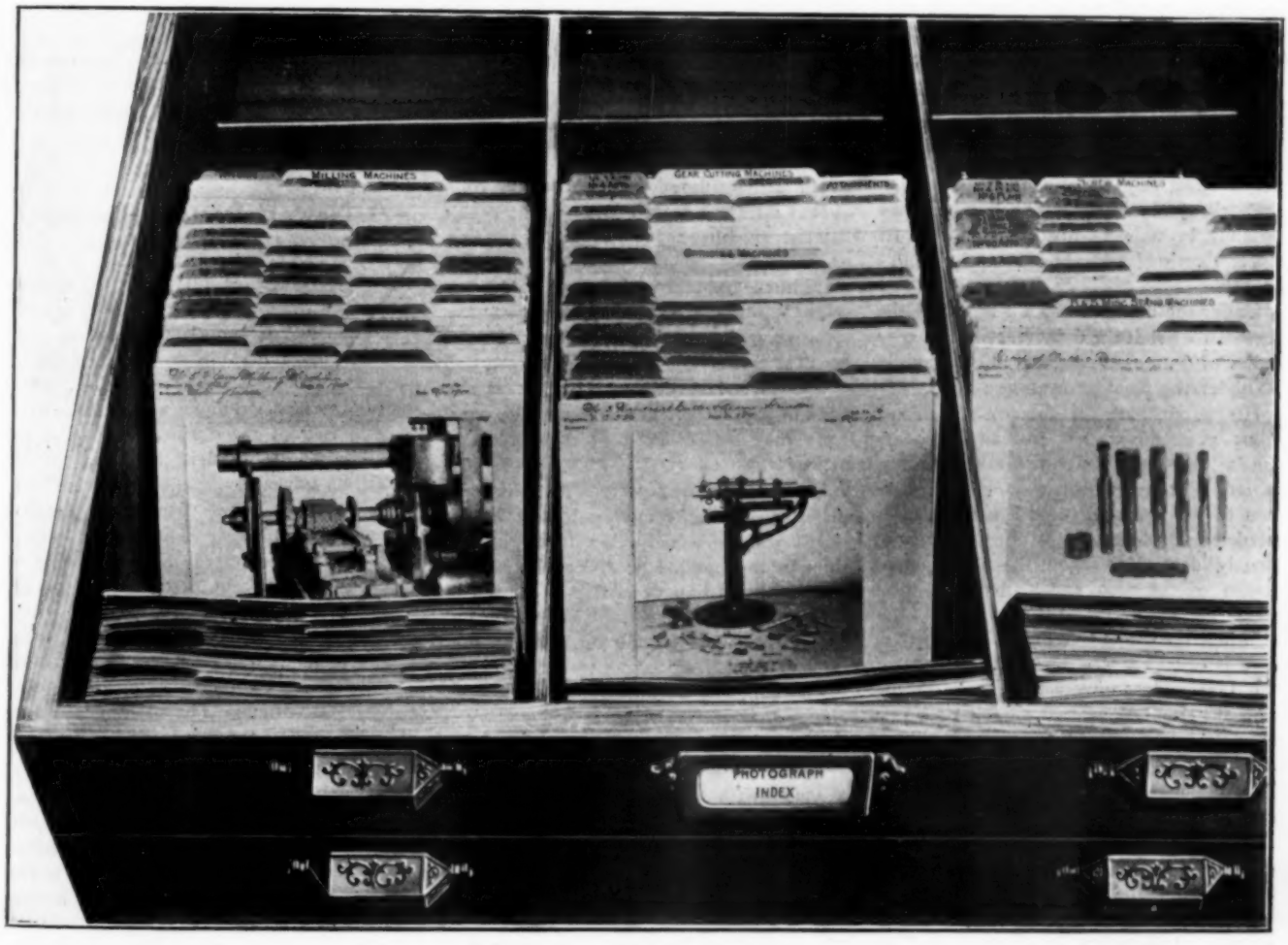


FIG. 6. A PHOTOGRAPH INDEX DRAWER

modification of the Halsey system—the modification providing that I was to receive a decreasing percentage of the saving instead of a fixed percentage.

I will endeavor to show why this scheme is a superior method when piecing out work through a foreman having a chance of gaining considerable extra remuneration from the fact of his being able to govern to a considerable extent the means of manufacture, and having a large number of men, each possibly yielding him a slight revenue. Bear in mind, however, that for my men I believe in the fixed percentage of profits and no change in the outside original price unless means of manufacture are altered.

I was aware of the fact that if the foremen were guaranteed a fixed outside price, and also a fixed percentage of the profits earned, that the company would be in this predicament:

The present selling price of an article due to methods of manufacture might be such as to yield a fair revenue if made at a labor cost of $100; our only competitor might also be in about the same condition. Now, supposing I am offered $90 as a fixed figure for producing this work in the future, and say 33⅓ per cent. of the saving I effect is given to me. Should I eventually reduce the cost to $50, due to my improving methods of manufacture, the company will not only feel I am getting too much, but as soon as our competitor also improves the system under which he is manufacturing the article he may be able to undersell us providing he is not giving a percentage to the foreman. On the other hand, his foreman will not be so effectively assisting him, owing to the lack of any inducements, but still may possibly be able to make his labor cost lower than our labor cost, plus foreman's profits.

Under the method which I advocate the foreman's profits are increased by every dollar of decreased cost, but not so rapidly as under the fixed percentage scheme.

His profits are in fact increased as labor goes down, but instead of bearing a close relation to the fixed estimated cost figure bear a closer relation to the actual cost, and the foreman's hard work obviously is on the average closely dependent upon the total actual wages of the men rather than the total costs.

When the general scheme of manufacture is changed, due to efforts outside of the foreman's control—such as introduction of new machines, etc., I believe it just to make a new outside figure to the foreman, but to absolutely never change the outside figure when the gain is due to the foreman, as I believe the decreasing percentage of saving scheme should be so carefully plotted out as to yield him only what is fully and permanently satisfactory to the company. The following table shows exactly what I requested and received:

A = Saving in labor on each $1.00.
B = Percentage of above saving given foreman.
C = Net gain to foreman on each $1.00 of labor.

A	B	C
$.01	75%	.0075
.02	73	.0146
.03	70	.021
.05	65	.032
.08	55	.044
.10	48	.048
.12	41	.0492
.15	36	.054
.20	28	.056
.25	24	.06
.30	22	.066
.35	19	.067
.40	17	.068
.50	14	.070

Example:—

Allowed..$200.00 for a job.
Cost..... 160.00 in labor.

Apparent saving..... $40.00 = $\frac{40}{200}$, or 0.20 on each $1.00.

Reading table at .20 indicates 28% of profit to go to foreman; 28% of $40.00 = $11.20; total cost to company in labor and foreman's profit = 160 + 11.20 = $171.20.

In case column C yields more than is considered necessary it may be reduced by dividing the percentage column B by a constant number, and still yield to the foreman an increasing amount for each $1 saved. Column B should be carefully decided upon with thought given to the total wage controlled by the foreman.

Probably a modification of these figures might be considered advisable under conditions different from mine.

It is, of course, possible to fix by this profit-sharing scheme approximately the maximum amount a foreman could receive by taking into consideration the total wage he controls and estimate the greatest conceivable reduction in cost.

The foreman realizes this, but if the amount is sufficient to tempt him the company may rest assured of the foreman's most earnest efforts.

In case the fixed percentage scheme is installed by the company the inevitable result will be a reduction from time to time in the outside or theoretical figure, and the great danger is that the foreman will undoubtedly feel that for his greatest efforts he is getting no more than if he had done less owing to the difficulty in the company deciding upon the proper cut.

The decreasing percentage scheme amounts in effect to the fixed percentage scheme, with an automatic reduction in the outside figure in case of extraordinary results, which is exactly what the managers as a whole I believe think is correct.

The question may arise why do I not also advocate the decreasing percentage scheme to cover the workman's gain? My answer is that the difference in his day pay for producing work for example 30% under a figure, as compared to 10% would not be enough to induce him to make the extra effort. With a foreman drawing revenue from a large number of men the addition of each small amount gained in percentage results in quite a total in money, and money is the object apt to spur the foreman on.

To my assistants who control sub-divisions of work I make an original outside figure somewhat in excess of the total, as covered by contracts made out to the men, and in case they have so supervised the work as to bring it out under their figure, they get a percentage of the saving made, the percentage being on a decreasing scale.

In addition to what may be termed productive-labor cost, the manufacturer also has his shop expense or non-productive cost to consider when figuring up total costs.

In many shops this shop expense is figured up periodically, and an average rate for each productive labor hour computed.

I consider that in this event it is best for all concerned to weave the total shop cost into the foreman's contract or allowed figure, and to have it understood that this figure represents the total of productive and non-productive labor, and other shop expenses.

The percentage given to the foreman in this event on savings affected should, of course, be lower than when computed on the actual labor cost.

A New Refractory Material

A new refractory material for use in pyrometer tubes, pipes, muffles, plates, crucibles, etc., is being introduced in this country by the Wilson-Maeulen Company, 110 Liberty street, New York. This material, which is known as electroquartz, is composed of fused silica, a pure silica product of the electric furnace. It is stated to have all the properties of the quartz product made from rock crystal except transparency. The maker states the material possesses a low coefficient of expansion, thereby permitting it to undergo violent temperature changes without cracking. It will withstand a temperature up to 1400 degrees Centigrade (2552 degrees Fahrenheit), at which temperature it softens. The melting point is 1600 degrees Centigrade.

Lifting magnets are coming into increasing use in British iron works. Castings weighing two to three tons are lifted by electro magnets. Much time is saved in comparison with the use of hooks, slings, and other devices, as the mere throwing of a switch energizes the magnet.

The Forging of Alloy Steels

Showing the Effect of Temperature, Methods of Forging, Welding and Annealing on the Production of High-grade Forgings

BY E. F. LAKE

The alloyed steels, such as nickel, chromium, vanadium, silicon, tungsten, and several other alloys as well as different combinations of these, are coming into more general use every day for the parts of high-grade machinery which are subjected to a high rate of wear, which have to support a great weight or which are subject to excessive strains, stresses and vibration.

Many of the parts for which these alloyed steels are used are too intricate in form to use the regular rolling-mill shapes and the alloyed steels have not, as yet, been cast successfully, except in a few instances.

Nickel-steel Castings

Nickel steel is being cast by one foundry and manganese steel by another, but the latter, being too hard to machine by the ordinary methods, is produced only in castings and is not forgeable. Its uses are therefore limited and it does not come within the scope of this article, except that manganese, in small percentages, is a component of nearly all the alloyed steels.

For these parts which cannot be produced from the rolling-mill shapes, or made in castings, forging is resorted to and there are several different ways of turning out these forgings: by hand, under a steam hammer, in a hydraulic press, or in a drop-forging press. The cost of these different methods of production depends largely on the number of pieces required of the same shape, but the size of the piece to be forged as well as the components of the steel have an influence on which is the best as well as the cheapest method to use.

Hand Forging

When small pieces and but few of a kind are wanted, the hand forging is undoubtedly the cheapest; but for large pieces, or where a large quantity is wanted, hand forging is the most expensive way of producing them and the strength is not apt to be as great as by any of the other methods. With a blacksmith shop properly equipped, a skilled smith can make forgings that are stronger than a rolled bar from the same ingot. To do this it must be hammered between the proper temperatures, which vary with different alloys of steel.

Forging Nickel-chrome Steel

A nickel-chrome steel must be kept at 2200 degrees, Fahr., which is a bright yellow color, all through the forging operations, while some of the carbon steels, particularly those that are high in carbon, cannot be heated to a temperature over 1800 degrees. Fahr., without burning the metal and when once burned it cannot be returned to its former state without remelting. The higher the carbon content the more danger there is of burning and a steel with 1 per cent. of carbon is very difficult to forge at all owing to the extremely low temperature at which it must be worked. The smith must also regulate the weight and effect of the blows so that it will be finished just as it reaches a blue heat. This will prevent the formation of large crystals, give the piece a dense, homogeneous grain with the atoms holding together by a high cohesive force and result in the steel having an increased strength.

Welds Do Not Average 50 Per Cent.

In many of the more intricate shapes that are hand forged, a resource is had to welding and if the average smith were told that he could not make a perfect weld he would feel greatly insulted. But from a large number of so called perfect welds that were examined very few showed a strength equal to 50 per cent. of the unwelded section. With the alloy steels it is difficult to get a weld that will even show that percentage as nickel, chromium, vanadium, tungsten, aluminum and some other alloys do not lend themselves to the welding process.

The Enemy of Welds

Carbon, however, is the principal enemy of welds and with this as low as 0.15 per cent. it must be handled with great care at the welding heat, while with 0.20 of carbon the steel is very unreliable and with 0.50 per cent. of carbon the steel is liable to be burnt at a temperature well below the welding heat.

Thus to make hand forgings where welds are necessary the pieces must be from 2 to 3 times the size of that necessary for the required strength and with some of the alloyed steels even this will not suffice.

Electric and Acetylene Welds

Where electric or acetylene blowpipe welding is resorted to these bad features are overcome to a great extent and stronger welds are secured, as these methods melt the metal, allowing it to run together and then solidify, thus making a more perfect joint.

The steel which is the best adapted for forging under the hammer has about the following composition: Carbon, 0.15 per cent.; silicon, 0.20 per cent.; manganese, 0.52 per cent.; phosphorus, 0.06 per cent.; sulphur, 0.04 per cent.

This steel in the annealed state will show the following physical characteristics: Tensile strength, 55,000 pounds per square inch; elastic limit, 30,000 pounds per square inch; elongation in 8 inches, 29 per cent.; reduction of area, 60 per cent.

When fractured it will show a silky fiber.

Using Higher-grade Steel

But for many purposes a steel of much greater strength than this must be hand-forged and then it becomes necessary for the smith to understand the nature of its component parts so he can forge it successfully, as many of the high-grade alloy steels can be rendered no better or stronger than the ordinary carbon steels by over or under heating and poor workmanship.

In many cases welds are absolutely necessary to produce the required shapes and a steel of the following composition is the best suitable for welding: Carbon, 0.080 per cent.; silicon, 0.035 per cent.; manganese, 0.110 per cent.; phosphorus, 0.012 per cent.; sulphur, 0.007 per cent.

In the annealed state it should show the following physical characteristics: Tensile strength, 48,000 pounds per square inch; elastic limit, 25,000 pounds per square inch; elongation in 2 inches, 27 per cent.; reduction of area, 69 per cent.

Nickel-steel Castings

For such work, however, a nickel steel casting, that is much cheaper than forgings, is being produced by one foundry that shows the following physical characteristics: Tensile strength, 78,000 pounds per square inch; elastic limit, 50,000 pounds per square inch; elongation in 2 inches, 25 per cent.; reduction of area, 42 per cent.

Direct steel castings are being turned out by several foundries that show the following physical characteristics: Tensile strength, 70,000 pounds per square inch; elastic limit, 35,000 pounds per square inch; elongation in two inches, 25 per cent.; reduction of area, 40 per cent.

Forging Steel Castings

These steel castings can be forged, welded, bent cold, tempered, and in fact

worked about the same as rolled steel. The nickel-steel castings can also be case-hardened, and are successfully used in place of forgings.

For pieces of considerable size and bulk the steam hammer is substituted for the hand-forging process. In this method of forging the hammer should be of a size to suit the size of the work. The hammerman must exercise a good deal of skill and judgment as to the power and speed of the blows delivered to the piece, as a too powerful blow will crush it and in the case of a high percentage of nickel, fissures and cracks are liable to develop which it will be difficult to get out, and which may show in the finished product.

Maintain Forging Temperature

This is especially true if the piece is allowed to fall below the forging temperature, or if the blows are not distributed evenly. If the blows are from a light triphammer, delivered at high speed, only the surface of the metal will be bruised and the core not affected, thus causing the core to be coarse-grained without the proper adhesion to insure the necessary strength.

A heavy hammer descending on the work at a slow speed will penetrate the mass to the center and allow the particles of metal to flow to their proper position and insure a fine grain of even texture and be uniform throughout its entire size.

Forging Large Pieces

The keeping of the heat to a good forging temperature is more difficult than in the hand forgings owing chiefly to the difference in the size of the piece forged, as the hand-forged piece is usually small enough for the smith to put in the fire and reheat it the minute the temperature falls below the best forging heat. But the hammer-forged piece is many times large enough to be handled with a crane, and is therefore liable to be kept under the hammer as long as a blow will have any effect on it.

This results in a very uneven structure as when the metal is hot the blows will penetrate to the center, and as it cools they have less and less penetration until only the skin is affected, and the annealing, which is resorted to afterward, cannot bring it back to the proper homogeneity, as some parts will have a denser grain than others and therefore be stronger.

When It Pays to Use Dies

When enough pieces, of one shape, are wanted to wear out a set of dies, the cheapest and best way of producing these in the high-grade alloy steels, is by the drop-forging process. They can then be made in one piece without welds, except in pieces which are many times longer than a section through them and these are so difficult to keep at the proper temperature that they are usually forged in two or more pieces and then electrically welded together.

A good illustration of this is the front axle of an automobile, which is usually forged in I-beam section, 4 inches from the top to the bottom of the I, 2½ inches across the flange, with the web ¼ of an inch thick, and a length of from 48 to 54 inches. These are generally forged in two halves and electrically welded in the center, but a few of them are forged in one piece, although the first cost of the dies and the liability of their breaking, owing to the axle cooling before the forging operation is completed, has made this method very expensive.

Drop Forging or Squeezing

In the drop-forging process two methods are employed, one being the ordinary drop-forging process, which hammers the metal into shape, and the other is the hydraulic press, which squeezes it into shape. With both of these methods dies are necessary, and these are usually made of a 60-point carbon steel and in two halves, an upper and a lower one, they being generally parted on the center line; but the shape of the piece controls the location of the parting line.

The dies are always given from 6 to 7 degrees draft, so the forging will fall out easily, and they are left open on the parting line from ⅛ to ¼ of an inch, according to the amount of metal in the forging. The amount of stock is always greater than that in the finished forging, so it will completely fill the die, and the surplus is squeezed out at the opening on the parting line. This fin is afterward trimmed off.

Setting the Dies

One of the first and most important points in die forging is the setting of the dies, as the upper half, which is fastened to the ram, and the lower half, which is fastened to the anvil block, must come exactly in line to produce a perfect forging.

The lower half of the die should have a current of air blowing in it that is strong enough to remove all of the scale which works off the piece being forged, and this should be regulated or it will not cool the hot metal being forged. Steel-wire brushes can be used for this purpose, but the air is quicker, and if well adjusted is more positive. The upper half of the die should be kept well oiled so the scale will not stick to that. This can be done by rubbing a swab, well soaked in oil, through the die every time it is raised off the work.

Accurate Forging

With the dies properly set and the press adjusted so the two dies will come together on the parting line, the work can be turned out to one thirty-second of an inch of the finished size, thus making much less machine work than by the hand-forging process, and when grinding is to be used in finishing, the work can be brought to within one one-hundredth of an inch.

After forging the pieces should be placed in a pickling bath, of a diluted solution of sulphuric acid, to dissolve the oxide or scale, after which they can be submitted to a sand blast, if a still better surface is desired.

The cost of drop forgings depends on the number needed and the number that can be turned out at one setting of the dies, as well as on the quality of the steel used.

Forging and Welding Alloy Steel

By the die-forging and electric welding methods the highest grades of alloyed steel can be turned into forgings successfully and their strengths and elongation retained, but this is almost impossible by the hand or hammer forging methods, especially if welds are made necessary by the shape of the piece. One of the alloy steels that is being manufactured into die forgings has the following chemical composition: Chromium, 1.50 per cent.; nickel 3.50 per cent.; carbon, 0.25 per cent.; silicon, 0.25 per cent.; manganese, 0.40 per cent.; phosphorus, 0.025 per cent; sulphur, 0.03 per cent.

In the annealed state this shows the following physical characteristics: Tensile strength, 120,000 pounds per square inch; elastic limit, 105,000 pounds per square inch; elongation in 2 inches, 20 per cent.; reduction of area, 58 per cent.

When properly heat treated, that is quenched in oil and drawn, these characteristics became: Tensile strength, 202,000 pounds per square inch; elastic limit, 180,000 pounds per square inch; elongation in 2 inches, 12 per cent.; reduction of area, 34 per cent.

Defects Due to Drop Hammer

The inferior quality of many die forgings is undoubtedly due to the drop-hammer process, as this has a tendency to produce only a bruising effect owing to the top die descending at a high speed and delivering a light blow which has no penetration. The hydraulic press, on the other hand, produces forgings of a far superior quality because it slowly squeezes the metal into the shape of the die, thus allowing it more time to flow into place and assume its new shape and therefore making it more uniform in quality with a great deal lower degree of internal strains.

To remove the internal strains caused by working the metal all forgings, no matter how they are made, should be annealed before using, as the shocks to which the forging may be submitted will concentrate at the point where these internal strains are the strongest, causing it to break at that point. The results are very similar to the machinist notching a bar in order to break it.

Heating Too Suddenly

Many poor forgings are also turned out by raising the temperature of the metal too suddenly. Certain molecular changes take place in the heating of all steels, and of the alloy steels in particular which are liable to cause fissures in the core of the metal, and these may not show in the finished product as they do not always break through the skin or outer shell of the forging. Thus by heating suddenly the outer shell becomes red before the core has had an opportunity to absorb any heat and the outer shell expands, causing great strains on the core of the piece.

In the case of a high percentage of nickel these fissures become more pronounced than with the other alloys.

When Steels Lose Ductility

At a temperature of about 600 degrees Fahrenheit or a bright blue, most steels lose their ductility and are not fitted to resist strains imposed upon them by the differential expansion of an unevenly heated metal. Therefore the rise in temperature from the normal to 600 degrees, should be a gradual one, but after this it may be brought up to the forging heat as quickly as is desired.

Chromium produces a mineral hardness in steel and steels containing this alloy are difficult to forge, but if the temperature is kept above 2200 degrees Fahrenheit, or a bright yellow, and never allowed to fall below this it can be forged successfully.

This would require frequent reheating as the melting point is 2500 degrees Fahrenheit, and it cannot reach this temperature. With this steel it is best to make the dies with shorter steps between the different pairs than for the ordinary carbon steels.

Easier to Forge Nickel Steel

Steels containing nickel are more easily forged, but these must be handled carefully owing to its tendency to produce fissures.

The vanadium steels are more easily forged than either of these, and if due care is taken to increase the heat gradually at first—that is, this steel should not be plunged into the heat all at once—no trouble will be experienced afterward.

Effect of Silicon

Silicon in small percentages does not effect the forgeability of steel, but in large amount it gives steel a fibrous grain and is therefore used principally for springs. But in the last few years this steel has been forged into gear blanks to quite an extent. In this case the blanks should be made in the form of forged rolls, and not cut from bars, in order to avoid the fibrous structure.

The aluminum, tungsten, titanium, manganese and other alloyed steels are not used to any extent for forgings, as those before mentioned show superior qualities and some of the last named are much higher in price.

Tin, Titanium and Cobalt Steels

By Robert Grimshaw

Nowadays the term "steel" is applied not only to the various mixtures and compounds of carbon with iron, but to many alloys of different metals with iron in the presence of carbon in various conditions of mixture or combination. Some of these new alloys have proved themselves to be among the most remarkable and valuable of the series known under the general name of steel; and metallurgists are constantly adding to their number.

It might have surprised us ten years ago to hear of "tin steels;" but nevertheless they exist, at least in the experimental laboratory of the steel-manufacturer; and some of the most interesting researches therewith have been made by Mons. Léon Guillet, in connection with a series on other alloys of iron. In a paper read before the French Société des Ingénieurs Civils, Mons. Guillet discusses the properties of the tin, titanium and cobalt alloys with iron, as revealed by the microscope after etching cross sections of the various specimens.

The Tin Steels

Up to 5 per cent. of tin, according to Mons. Guillet, the constitution of the alloy is the same as in the case of ordinary carbon steels. Commencing with 5 per cent., the etching shows about the pearlite white spots similar to those found in certain silicium steels. With 10 per cent. of tin, the white spots are more prominent, but there is no trace of graphite. All the carbon is in the state of iron carbide.

In the beginning, the tin enters into solution in the iron; and when saturation ensues, separates in the form of a definite compound; the carbon always remaining as iron carbide, at least up to 10 per cent. of tin.

The tin steels cannot be rolled, if there be more than 1 per cent. of tin present; they are extremely hard and brittle. Annealing has the same effect upon these as upon the ordinary steels; there is in no case precipitation of the carbon in the state of graphite. Hardening produces martensite only where there is pearlite beforehand; it seems that the ferro-stannide solution of iron does not dissolve the carbon.

Titanium Steels

Guillet studied titanium steels up to an alloy with 9 per cent. of titanium; some of these specimens contained but little carbon, the others up to about 0.70 per cent. The microscope seemed to show that the titanium entered into solution in the iron.

Mechanical tests showed no sensible improvement in the quality of the steel; in all cases where there was a high percentage of carbon, the tensile strength was higher than for ordinary steels; it would seem that the ferrite of these alloys was harder than that of ordinary steels; as through all the titanium was concentrated therein. The table shows the results of the tests:

Annealing acts on these steels as on ordinary ones; hardening modifies them as it does these last, but the effect is less marked.

In fine, says Guillet, micrographic and physical tests show that titanium has but little influence on the properties of steel, and that its alloys have no industrial value.

Cobalt Steels

In the matter of the cobalt-iron alloys, Guillet has made investigations up to a cobalt percentage of 60; all the specimens being perlitic, and the cobalt making no difference in the iron-carbon combinations. The mechanical properties are but little modified, only the breaking strength and the elastic limit cross slowly, while the elongation and the reduction in cross-section are inversely modified. The cobalt steels have no industrial interest and do not present any of the qualities of the nickel steels.

Composition.		Mechanical Properties.					
C	Ti	Tensile Strength Kg. per Sq. Mm.	Elastic Limit Kg. per Sq. Mm.	Elongation Per Cent.	$\frac{S-s^*}{S}$	Shock.	Hardness.
0.122	0.475	40.7	33.9	20.0	68.4	25	99
0.137	1.39	48.2	36.1	19.0	62.1	25	101
0.139	2.57	45.2	34.6	17.5	68.4	29	90
0.760	0.325	94.1	54.9	7.5	19.0	3	207
0.611	2.57	90.4	58.8	10.5	34.7	3	212
0.635	4.63	89.8	57.8	9.5	34.2	4	212
0.65	8.71	117.5	62.5	8.5	39.7	5	248

*S = Original cross section.
s = Cross section after rupture.

In general, Guillet's researches go to show that the tin, titanium and cobalt in steels enter into solution in the iron, and that the carbon exists therein—at least in the range of the experiments made—in the shape of iron carbide. The mechanical properties of these steels do not seem to promise any industrial application thereof; they show very clearly the marked difference between tin, titanium and silicium steels on the one hand, and nickel and cobalt steels on the other.

Consul-General R. J. Wynne, of London, reports that according to statistics just published by Lloyd's Register the merchant fleets of the globe now total 39,438,000 tons. Of this huge total no less than 33,969,000 tons represent steam shipping, and 17,001,000 tons of it is under the British flag. All the principal maritime countries have added to their merchant navies except Spain. The increase in the case of France is nominal.

The Design of Eccentric Pull and Push Rods

By H. M. Prevost Murphy

An extremely practical problem which confronts builders of many types of mechanical devices is the design of eccentric pull or push rods. Such rods are, perhaps, most extensively used in connection with the brake rigging of railway cars. Although it is ordinarily possible to lay out a system of levers in such a way that all rods are subjected to either tension, compression or flexure alone, there are many cases in which it is essential to use rods bent in such a way that compound stresses are involved. For instance, it is often necessary to pass around some obstruction attached to a car, as a motor, reservoir or other device, which cannot have its location changed. The common forms of rods used for this purpose are shown in Figs. 1 and 6.

In past years, when the weight of cars was less than 50 per cent. of what it is today, the design of these eccentric rods was a comparatively simple proposition, and in most cases amounted to nothing more than taking a rod that "looked strong enough"

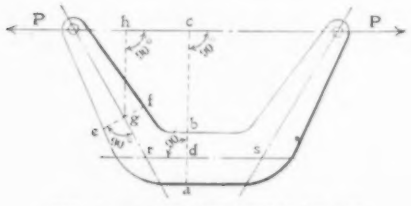


FIG. 1. A COMMON FORM OF ROD

and bending it into the desired shape. Now, however, the problem can no longer be satisfactorily solved in this manner; for not only have the actual weights of the cars increased enormously in the last few years, but also it has been found practical and advantageous to increase the total braking power obtainable in cases of emergency from 70 per cent. or 80 per cent. to as much as 150 per cent. of the total weight of the car. In other words, the stresses encountered today in car-brake rigging are, in many cases, four times as great as those dealt with a few years ago, and it has become requisite to establish some accurate and reliable method of designing eccentric rods which should obviously be figured with as great care as any other part of a leverage system. As the general principles are the same for all eccentric rods, no matter how complicated their shapes may be (as will be readily seen from the following discussion), only the two most common types will be analyzed here.

Consider a rod of the form shown in Fig. 1 and subject to the tensile forces P. To find the necessary strength of any section, as $a\,b$ or $e\,f$, it is only essential to find the forces acting on it. Now it is a well-known fact that to balance a force acting on a body it is necessary to apply an equal and opposite force acting in the same line, as is shown in Fig. 2, or an equal and opposite force acting in another line plus a couple having a moment equal to that of the applied and resisting forces, but opposite to it, as is shown in Fig. 3.

By applying the principles thus illustrat-

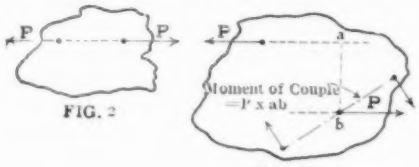


FIG. 3

DIAGRAMS OF BALANCED FORCES

ed it is easy to find the stresses in any section of a rod like that shown in Fig. 1, for assume it to be cut in any section, as $a\,b$, and the force P still applied to its end, as shown in Fig. 4. It is evident that equilibrium may be preserved by applying to the section $a\,b$ the force P'-P-T, and the couple $m\,n\,Q\,Q$ equal and opposite to $P\,P'\,c\,d$. Consequently these forces must represent the resultant fiber stresses acting at the section $a\,b$ (before the rod was cut); for, if there were any additional force applied at $a\,b$, the equilibrium would be destroyed. That is, the section $a\,b$ is subject to a direct tension T and a bending moment whose value is given by the couple $Q\,Q\,m\,n$; consequently, the section $b\,d$ is subject to a combined tension, resulting from that due to T and that due to flexure, whereas $a\,d$ is subject to a stress which is the difference between the compression due to flexure and the tension due to T. It is evident from the above that the section of the rod from r to s, Fig. 1, will be constant, as the tension T and the bending moment will be the same for all points between r and s. But for a point, as g, Fig. 1 or Fig. 5, that is one on the leg, the bending movement decreases as g recedes from r, also the leg is subject to a shearing stress as well as tension and compression.

To find the section of the rod at g, ex-

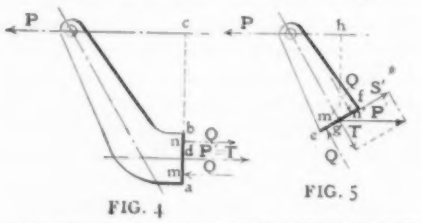


FIG. 4 FIG. 5

DIAGRAMS OF FORCES AT TWO POINTS OF THE ROD

actly the same method is employed as in finding it at d. By referring to Fig. 5 it is seen that the force P is balanced at g by P' equal and opposite to P and by a couple $Q\,Q\,m'\,n'$ equal and opposite to $P\,P'\,g\,h$. Now P' when resolved into its components parallel and particular to the leg gives S' a shearing stress and T a direct tension which may be combined with the stresses of tension and compression due to flexure in exactly the same way as in the case of Fig. 4. The bending moment of the couple $P\,P'\,g\,h$ is of course equal to P times the distance $g\,h$.

To design a rod of the type shown in Fig 6, let

P = pull to be transmitted,
G = reaction of guide or hanger, and
R = resultant force acting on the rod.

To balance R, the resultant stresses shown in Fig. 6 must act on any section $b\,c$. The force lines of course indicate the action of the right-hand portion of the rod on that to the left of the section. The resultant forces exerted by the left-hand portion on that to the right are of necessity equal and opposite to those indicated. It is obvious that this case is exactly the same as the preceding ones; the section $b\,c$ is subjected to a bending moment R' x ad, a tension T, and a shear S', which may be readily found graphically as above, or by the principles of trigonometry.

In cases where any of the above rods are subject to external compression instead of tension, an exactly similar method of solution may be employed; the forces P are

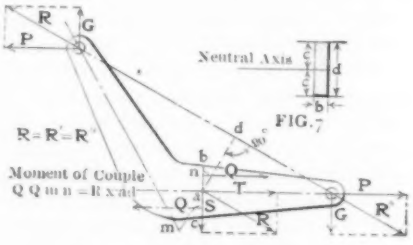


FIG. 6. ANOTHER FORM OF ROD

merely reversed and the necessary changes made in the diagrams.

To derive a simple formula for finding the correct cross-section of any eccentric rod, as for example, one of the above forms of rods, under *tension*, the following method may be employed:

Let

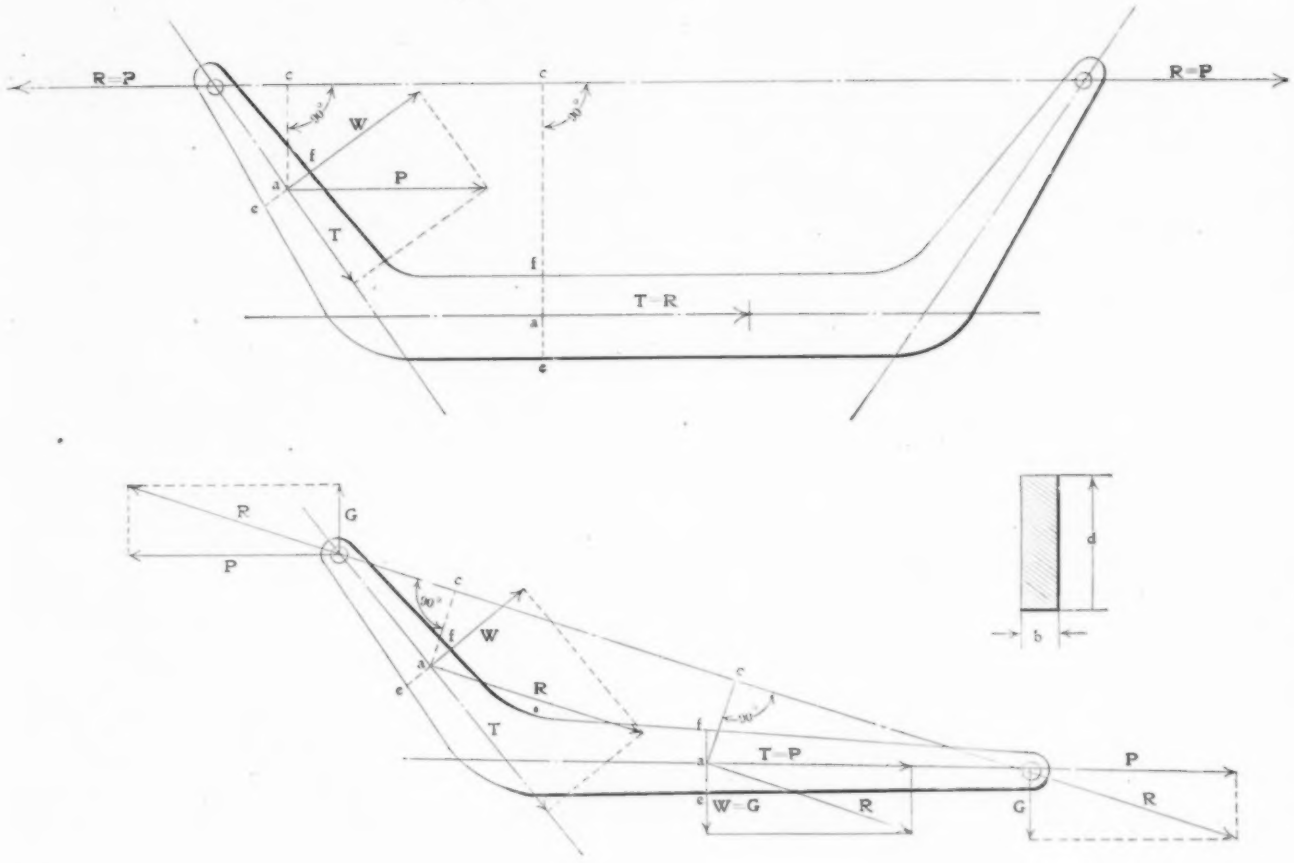
S = Safe tensile working stress per square inch;
S_1 = Tension per square inch due to flexure and
S_2 = Direct tension per square inch (due to action of T).

Consider a rectangular section of bar like that shown in Fig. 7, and let:

M = Total bending moment in the section considered, and
T = Total direct tension on whole section, as found from above sketches; then $M_1 = S_1 \times \frac{b\,d^2}{6}$ by the principles of flexure

and $S_2 = \frac{T}{b\,d}$; also $S = S_1 + S_2 =$ safe working stress per square inch, therefore $S_1 = S - S_2 = S - \frac{T}{b\,d}$ whence,

$$M = \left(S_1 \frac{b\,d^2}{6}\right) = \left(S - \frac{T}{b\,d}\right)$$



P = Total pull to be transmitted by rod—measured in pounds.
G = Reaction of guides or hangers, if any be used.
R = Total resultant tensile force acting on rod.
T = Total direct tensile force due only to direct pull of R on section.
W = Total shearing force on section.
M = Total bending moment = $R \times a\,c$, for any section $e\,a\,f$, ($a\,c$ to be measured in inches).
S = Safe working tensile stress per square inch.
U = Safe working shearing stress per square inch.
d = Depth or width ($e\,f$) of rod in inches ; measured perpendicular to neutral axis.
b = Thickness of rod.

The value of d, for any section considered, may be found by the following equation :

$$d = \frac{T + \sqrt{24 \times S \times b \times M + T^2}}{2 \times S \times b}.$$

For ordinary forms of rods no attention need be given to shear except at bolt holes ; but if so desired, the following formula may be used for any section as ($e\,f$) :

$$d = \frac{1\!\!1 W}{U \times b}.$$

DIAGRAM AND FORMULAS FOR THE DESIGN OF ECCENTRIC PULL AND PUSH RODS

$$\times\left(\frac{b\,d^2}{6}\right)=\frac{S\,b\,d^2-T\,d}{6};$$

or $Sbd^2 - Td = 6M$, or completing the square and dividing by Sb

$$\left(d-\frac{S}{2\,S\,b}\right)^2=\left(\frac{1}{2\,S\,b}\right)^2 \times(24\,S\,b\,M+T^2)$$

and taking the square root of both sides

$$d-\frac{T}{2\,S\,b}=\frac{1}{2\,S\,b}\times\sqrt{24\,S\,b\,M+T^2},$$

whence we get

$$d=\frac{T+\sqrt{24\,S\,b\,M+T^2}}{2\,S\,b}.$$

That is by using the above formula for d we may find the width of the rod in any section. The thickness b is usually assumed, and T and M are always easily found in any given problem, as is shown in Figs. 1 to 6; moreover, S is known for any material that is used.

For rods under external *compression* instead of tension, a formula similar to the above may be used for determining the maximum *compression* in any section, but such beams should also be investigated for the resultant *tension* due to the difference between the tension, caused by flexure, and the direct compression. To investigate a rod in this manner, a formula may be readily developed, by a method similar to the above, to give the value of d when the safe tensile strength is considered. As this form of rod is not at all common, no formula will be deduced here to cover it. When any such case does arise the general principles outlined above may be easily applied to it.

Given: $P = 40{,}000$ lbs.—Angle of Legs $= 45°$.

Find setion of bar at (aQ where $a\,c = 10''$ and $b = 2''$, using $S = 20{,}000$ lbs.

By the graphical resolution of forces, or by the fact that $T = P \times$ cosine $45''$ and $W = P \times$ cosine $45°$, we find $T = 40{,}0000 \times .7071 = 28{,}284$ and $W = 40{,}000 = .7071 = 28{,}284$.

For section $(e\,f)$, $M = 40{,}000 \times 10 = 400{,}000$, therefore

$$d=\frac{28{,}284+\sqrt{24\times 20{,}000\times 2\times 400{,}000+28{,}284\times 28{,}284}}{2\times 20{,}000\times 2}=8.1''.\quad\text{Answer}$$

FIG. 8. AN EXAMPLE IN THE DESIGN OF ECCENTRIC PULL RODS

Fig. 8 shows the solution of a simple problem, and the page insert, gives the diagrams and development of the formula.

The Chilean Government has purchased 25 heavy American locomotives to be used on the heavier grades of the State railways. They are found to give better service than the English or German engines.

Locating a Crane Trouble

By S. J. Kelley

For the benefit of some young mechanics and a few older ones who have trouble with electric cranes, my experience as a repair foreman in a large manufacturing plant in western New York may be of interest.

On one occasion the firm put in a new crane, but it gave a great deal of trouble after it had run enough to loosen up a little. It would run along smoothly for a short distance, then it would groan and jerk as if it were trying to see how much noise it could make, or to pull the iron girders down. It had a special peculiarity of wanting to do its worst every time it got over the superintendent's office, and all hands in the office would jump and stare out of the windows.

The superintendent wrote to the firm which made the crane, and it sent on one of its experts to remedy the trouble. He brought new wheels with him, worked most of the night and found that in running half the length of the shop (which was 500 feet and 40 feet span) one end of the crane would be 10 inches ahead of the other. He decided that the gears were not set properly. Then he took off the pinion, moved the crane until it was straight, and put it in gear again. It ran fairly well the next day, and he went home satisfied; but in two days it was as bad as, or worse than, before. In a week it ground out the boxes of two journals and still ground off the flanges of the wheels.

What the Other Expert Said

Another expert came from the factory and looked the crane over. He decided it was in the track and quoted a similar case in Buffalo. He advised the superintendent to have the track fixed at once and left for home, thinking he had solved the mystery. The superintendent called me to the office and told me to put men on the track and stay until it was right.

I got the carpenter to make a truss to tram the track. The truss was of 1x2½-inch wood and 40 feet long, with an 8-foot arm on one end. Then two angles were put on, to act as stops against the rail. First we struck a line on one track, got it as near as possible and leveled all the rail joints. Then we put up the tram and marked off the span of the crane. The truss was strung, top and bottom, with piano wire, to make it rigid and light. We then had one man to keep the two stops tight to the track just put in line. The opposite rail was set to the mark on the tram and moved along two feet at a time, until we reached the 500 feet of track. Then I had the men ratchet four holes in each rail and girder and dowel the rails solid. But the crane acted just the same as before. It really did seem, the more I did the worse it acted, and I began to think I was beaten at last.

Where the Trouble Lay

But I started in again by calipering the driving wheels and found one 3/16 inch larger in diameter than the other. Figuring it out, I found that the crane in the 500 feet of travel would try to run one end 11 feet farther than the other. It would run and grind on the track until it could not go any more; then it would let go with a groan that would frighten the operator. Then I set a straight edge across the carriage tracks and dropped plumb lines to the centers of the journals and trammed to the center of the crane on each rail, and the same distance across the rails.

Then I lined up with the center of the crane track, trammed across corners and found that end out ¼ inch. I repeated the operation on the other end. This showed it to be out ⅛ inch, making ⅜ inch in all; and this, combined with the difference in the wheels, made it impossible to run a high-speed crane with justice to itself or the firm that made it.

The builders' best expert trouble man came with new wheels and journal boxes; but after he looked the crane over, he decided as did the other expert that the track was out and not the machine. I offered to bet him that the track was nearly perfect, but he just smiled.

The Track Was All Right

Then he got a surveyor to put his instruments on the track; he found it out ⅓ of an inch in the 500 feet and pronounced it the best piece of track he ever saw.

Then I told the expert where the trouble lay, and we went over the crane wheels and found the new ones nearly as bad as the old ones. So we turned them down to the same size. Then he went over the crane the same as I had and found the trucks 7/16 inch out of line with the crane.

He then took out the bolts and dowels, reamed the holes and fitted new ones, and it trammed up well. We painted the face of the wheels, started the crane and ran to the end of the shop. The wheels showed a track in the paint all around in the center on all four of them, showing that the crane was in line with the track. Then we ran it to the other end of the shop, and it showed up the same. We ran it as fast as it would travel to the center, and stopped with the brake. It showed up well. The crane runs one-third faster than it would before and is O.K. in every way.

The Design and Use of Ball Bearings—I

How They Should Be Designed by Careful Computations and in the Best of Materials and the Characteristics of Good Balls*

BY HENRY HESS†

The field of usefulness of the ball bearing is as wide as the domain of mechanical engineering, or at least that portion of it which is concerned with the support of rotating or oscillating parts.

The limitation imposed on the use of the ball bearing in no sense differs from that imposed on any other element of mechanism. It must be employed in accord with the general prohibition against overloading and in conformity with its individuality. That sounds axiomatic and is self evident enough; but, self evident as it is, it is all too frequently disregarded.

Little information on ball and rolling bearings can be found in the usual engineering hand and text books. Generally the subject is dismissed with a casual reference; ocasionally a formula for carrying capacity is given, but this is usually wrong. Much matter is scattered through the technical press giving isolated experiences with a few bearings that happened to come within someone's observation. Insufficient information on almost every element that must be considered is undoubtedly responsible for the directly contradictory statements to be found and the generally accepted opinion that ball bearings are suitable only for relatively light loads.

This was the situation as Professor Stribeck found it when asked to investigate the subject for the German Small Arms and Ammunition Factories of Berlin. This concern, having been induced to go into the manufacture of balls and ball bearings, very soon found itself confronted with the imperative need for a scientific basis, if the manufacture was to be removed from the domain of haphazard blind working; resulting sometimes in success and sometimes in failure, the one as much a result of pure chance as the other—a situation peculiarly galling to the German engineer with his reputation for examining everything in the light of every authority—whether that be the million-candle searchlight of the modern, or the faint twinkle coming down the aisles of time from the rush light of the ancients.

With characteristic thoroughness Professor Stribeck took up the subject. He first applied the investigations of such men as Hertz, Auerbach and others on the deformation of elastic bodies to the development of formulas for static conditions, then by exhaustive tests determined constants for the materials, and followed with an investigation into the conditions of relative motion, and finally concluded the whole by a long and patiently conducted series of observations with actual bearings—thus not only proving the previous theoretical investigation, but also developing data for the use of the work-a-day designer and engineer. That this labor has been crowned with success is evident enough from a consideration of the uses to which ball bearings constructed along the lines laid down have been put in the last 10 years; these include not only light bearings for low and high speeds, but others for carying the 24-ton armatures of electric fly-wheel generators at 500 revolutions per minute, etc.

A word or two concerning the Central laboratories for scientific technical investigation (Centralstelle für Wissenschaftlich-

K for Older Materials	3 To 5.0	3 To 5.0	10
K for Improved Materials	3 To 7.5	3 To 7.5	15

FIG. 1
SHAPES OF RACES AND VALUES OF K

Technische Untersuchungen), at Neubabelsberg near Berlin, may not be amiss. Several of Germany's chief engineering works rather more than a decade ago, having experienced the urgent need of the thorough investigation of the many problems continually arising in connection with their manufacturing operations, decided to endow a coöperative institution to which these could be assigned. Such work could there be done by people not burdened with other duties and laboring in an atmosphere as remote as possible from the pressure for immediate results necessarily existing whenever a laboratory is the direct adjunct of and is located within the purlieus of a manufacturing establishment.

The laboratories were erected at picturesque Neubabelsberg on the banks of the Havel within an hour's reach of Berlin, and at an expense of some millions of marks. The annual maintenance is shared by the concerns in question. The writer happens to know that the share for one of these for one year amounted to about $150,000. It is this spirit of broadminded coöperation thus manifesting itself even among competitive manufacturers that undoubtedly has much to do with the extraordinary way that Germany has, from rather a poor agricultural community, forced its way to third place among the industrial commonwealths, and all within the last 30 years. This work of Professor Stribeck's undoubtedly is a classic in its field. The task of translation was made particularly easy by the clear cut and definite style of the original.

The Translator's Resume of Professor Stribeck's Report, and Notes Based on Experience

The translation of this report itself is referred to and should by all means be carefully studied, as it contains a very full, clear and concise account of the theoretical and practical investigation and demonstrations on which ball-bearing design must be based. For the statements and form of this résumé the translator alone is responsible, but believes that it may be accepted as a correct condensation of Professor Stribeck's work.

Sliding bearings wear out by abrasion of the carrying surfaces. Ball bearings do not give out from wear and do not wear. They may be ground out by admitting grit, but that is as illegitimate a condition for ball bearings as it is for sliding bearings.

The only legitimate cause of the giving out of ball bearings is the stressing of their material beyond the limit of proportionality. Lightly loaded bearings can be so designed as to eliminate this cause and so insure practical indestructibility. For heavily loaded bearings this condition is not realizable within practicable dimensions, but the proportions may be so chosen that the over stressing does not result in breakdown within the lifetime of any mechanism to which the ball bearing is applied.

A knowledge of the elastic qualities of the materials at the hardness under which they are used is imperative. It being the elastic behavior that is important with ball bearings as with all other engineering structures, tests of balls, such as are commonly made to determine ultimate rupture when pressed into a steel plate, and using the depth of indentation of the plate or load at which rupture occurs as a measure of ball quality, are not only of no value, but are misleading.

The quality of balls and ball races must be determined from their behavior under loads in the neighborhood of the elastic limit. Balls may be subjected to loads increasing as the shape of the supporting surface more nearly becomes complemen-

*Abstract of a paper presented at the Indianapolis, Ind., meeting of the American Society of Mechanical Engineers.

†President of the Hess-Bright Manufacturing Company.

tal to that of the ball. A ball running between races having a flat or straight line cross section will not support as great a load as though the section were that of a curvilinear groove. Such groove naturally must never have a curvature equaling that of the ball, since that would substitute sliding for rolling contact.

The frictional resistance of a ball bearing is lower the less the number of balls. Usually bearings can be designed to have between 10 and 20 balls. For that, with

P_b = total load on a bearing consisting of one row of balls;
P_o = greatest load on one ball;
z = number of balls;

$$P_o = \frac{5}{z} P_b .$$

(Stribeck's Equation 11)

The load-carrying capacity of a ball is

$$P_o = k d^2,$$

in which

d = the ball diameter,
k = constant dependent upon the material and the shape of the ball-supporting surface.

From Equation 11

$$P_b = P_o \frac{z}{5},$$

substituting for P_o from

$$P_o = k d^2$$

gives

$$P_b = k d^2 \frac{z}{5}.$$

As balls are usually made to English inches, it is convenient to take the one-eighth of an inch as unity. The table, Fig. 1, gives combination values of k for different cross sections of ball race and for the materials used in the first ball bearings tried out, and also for the improved steel alloys used later . These constants give P_b in kilograms.

If the centimeter is preferred as the unit for the ball diameter, then the tabular values for k are to be multiplied by 10, or, more accurately, 9.92.

Speed of rotation, in so far as it is uniform, does not affect carrying capacity. (This applies to radial bearings, but not to thrust bearings of the collar type; in these the carrying capacity decreases with increase of speed.)

But speed is rarely uniform; variations cut down the carrying capacity; sharp variations of small amplitude, particularly at high speed, have the more marked effect. Their reducing action is similar to the battering effect of sharp load variations.

Load variations reduce carrying capacity, the effect increasing with the amount of the load change and the rapidity of such change.

Accumulated experience with various classes of mechanisms is so far the only available guide for estimating the reductions in the constants k that must be made to take these influences into account.

The carrying capacity of a complete bearing is no greater than that of the weakest cross section that comes under the load. This applies to all those forms which have curved race sections of maximum sustaining capacity, except at a point where an opening is cut to permit the introduction of the balls; such bearings are, as to load-carrying capacity, governed by the weaker cross section at that point.

The calculated carrying capacity can be realized only if all balls sustain their share of the load. It is obvious enough that if a ball is smaller than those on either side of it, it will not carry its share of the load; should it be larger, it will carry more than its share and may be overloaded. Uniformity of ball diameter is essential. The permissible variation in ball diameter will be governed by the deformation produced by a relatively small part of the total bearing load, so that the balance of the load may be distributed over the several balls. Such permissible variations of ball diameters amount to but little more than one ten-thousandth part of an inch.

High finish of both ball and sustaining surfaces is essential. The presence of grinding scratches will very materially cut down the cited values of the constant k. Of course this presupposes true surfaces underlying the high polish. It follows from this requirement that rust and acid must be carefully avoided, as they are destructive of finish and truth of shape.

It may not be amiss to point out that uniformity of quality of material, of hardness and of structure throughout are essential. The mischief of using balls having different values of k is not simply confined to the individual ball; if, for instance, one ball were materially harder and so deformed less than its mates, it would take more load and might therefore overload the material of the race, which would yet be entirely suitable under a division of the bearing load among a larger number of balls.

The frictional resistances of ball bearings have, by actual measurement, been found to vary from 0.0011 to 0.0095. These are the coefficients of friction referred to the shaft diameter, thus permitting direct comparison with those of sliding friction. The higher values are due to conditions that cause a preponderance of sliding as compared with rolling friction. It must be remembered that there is no such thing as a bearing having only rolling friction; that might be possible were balls and races made originally with absolute truth of surfaces and were such truth then maintained by the absence of deformation under load. Ball bearings having a coefficient of friction materially above 0.0015 under the greatest allowable load are inadmissible because too shortlived. The high resistance indicates the presence of too large an element of sliding.

A good ball bearing will have a coefficient of friction, independent of the speed within wide limits, and approximating 0.0015. This coefficient will rise to approximately 0.0030 under a reduction of the load to about one-tenth of the maximum.

Materials

The prohibition against overloading demands recognition of the characteristics of the bearing materials.

Any material may be used that will not, under the working load, be so deformed as to prevent pure rolling. That means an absolutely inelastic material and one which unfortunately is, and more than probably will remain, undiscovered. But a slight narrowing is admissible to make the demand read: Any material may be used that will not, under the working load, deflect enough to prevent substantial rolling. That recognizes that all materials deform under load. Such deformation means change of shape from the original truth and that in turn will cause some sliding combined with rolling; this sliding must be held down to the irreducible minimum.

Any material may be used that will not, under the working load, be stressed beyond its elastic limit; that is a limitation which is possible of attainment. The tooth of time would be worn out against such a bearing. Its design is entirely practicable for light work, but for the heavier loads, the requirement would lead to, usually, impractical dimensions.

Fortunately, ball bearings, like various parts of the "Deacon's One Hoss Shay" are satisfactory if they last as long as their associated mechanisms. The requirement may therefore be modified to read: Any material may be used that will not, under the working load, be stressed sufficiently beyond the proportional limit, to bring about its destruction before the lapse of a desired working life.

These conditions permit the use of practically all of the materials known to mechanical engineering. With very few exceptions, however, the load conditions are such as to demand steels of the highest grades and these most carefully tempered. For automobile use, with which this paper is primarily concerned, no others can be considered. That puts out of the running all merely case-hardened materials. In these there is always a more or less sharply defined change of structure at some distance below the surface. Continued working will cause a loosening of the hard shell from the softer core, soon followed by a breaking up and very characteristic flaking of the surface. Usually this flaking is local; its action is increasingly progressive, soon involving the entire bearing.

What has been said of case-hardened materials holds true also for those carbon steels in which the hardening is not carried substantially and equally through the entire mass.

I have as a specimen half of a ball, in which a sharp structural change due to hardening occurs at a fairly uniform depth of one-sixteenth inch below the surface.

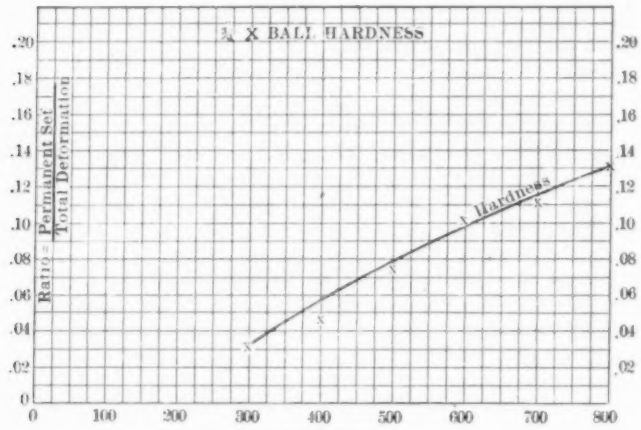


FIG. 2

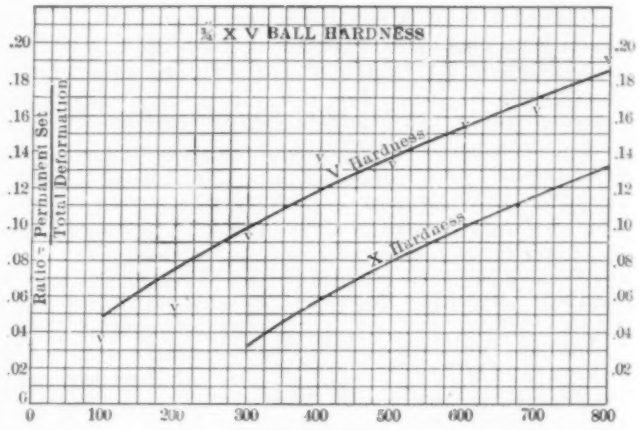


FIG. 6

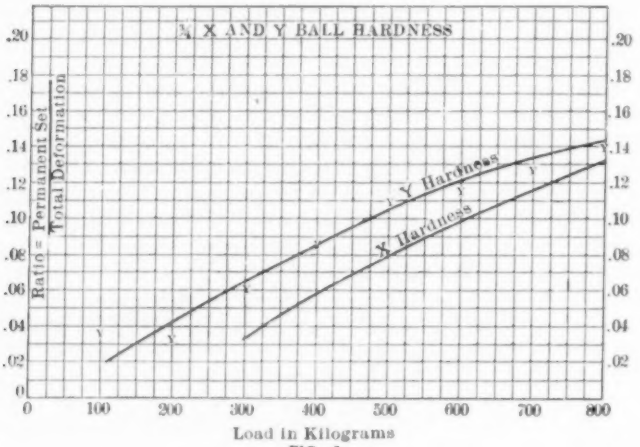


FIG. 3

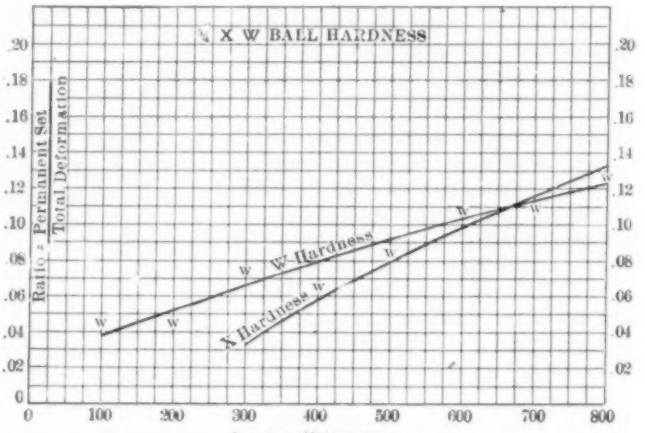


FIG. 7

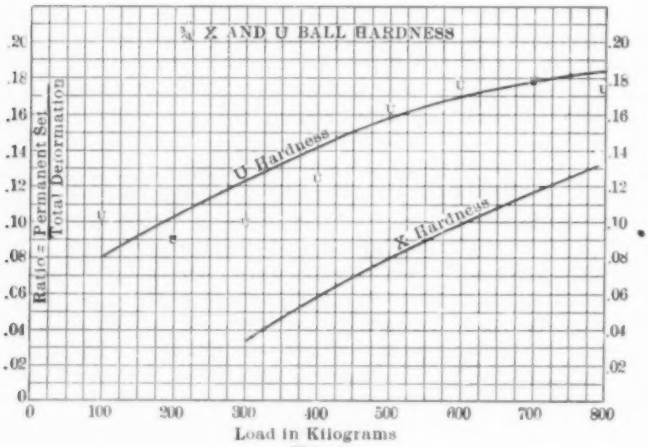


FIG. 4

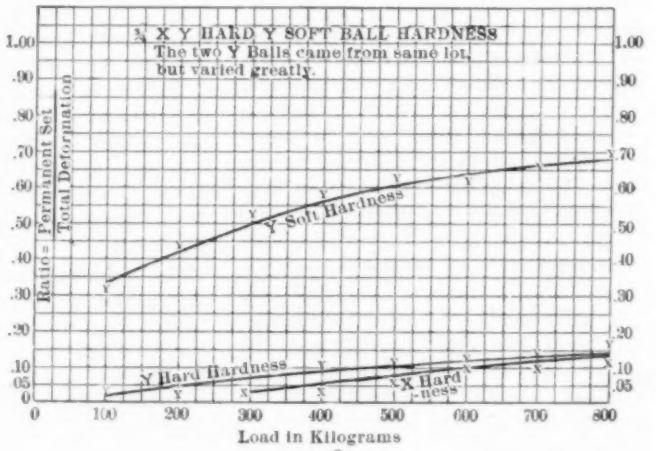

¾ X Y HARD Y SOFT BALL HARDNESS
The two Y Balls came from same lot, but varied greatly.
Ratio = Permanent Set / Total Deformation
Y Soft Hardness
Y Hard Hardness
X Hard -ness
Load in Kilograms

FIG. 8

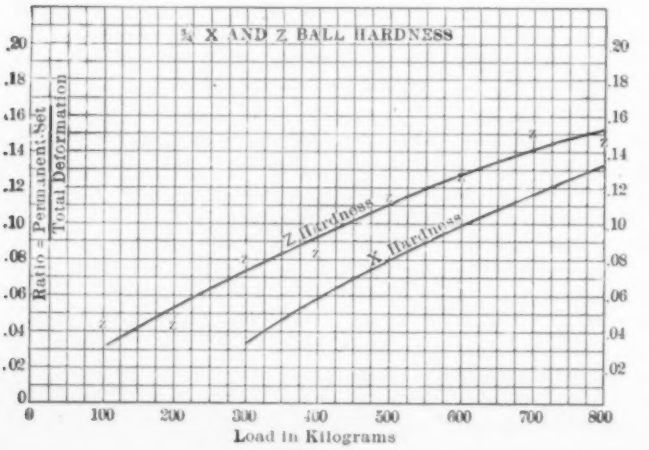


FIG. 5

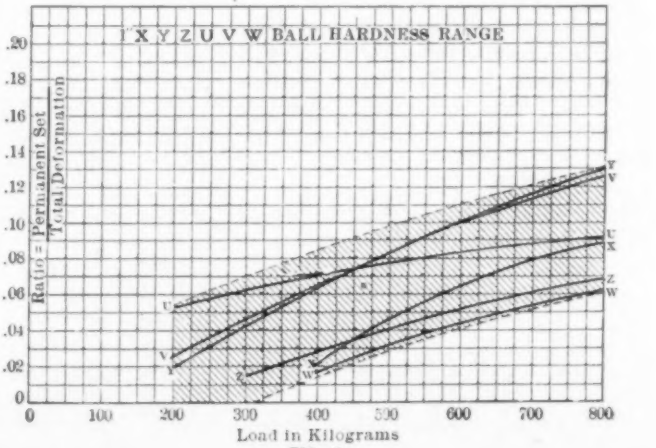


FIG. 9

DIAGRAMS OF BALL HARDNESS

The ball has evidently been run under conditions which shifted the load over its entire surface; it was used in a running test and then broken to examine its structure. It so happened that the ball was caught just before it was ready to fail by flaking. The entire hardened surface has been loosened from the core in such way as to form an inner ball. Some relative movement of this shell and inner ball has undoubtedly taken place, as is evidenced by the polished condition of the inner surfaces. This specimen was presented me by Professor Stribeck, who retained the other half.

What is true and required of the ball materials is even more so for the races. With time the ball presents its entire surface to the load, the small vibrations and changes of load being sufficient to frequently bring in a new axis of rotation. Not so the race; that is fixed and so always exposes the same surface element to the load attack.

The requirements of a good ball are: *a* Truth of shape and size. The permissible limit of error will vary with the character of the material. In general, the better the latter, that is to say the smaller its deformation under a given load, the more accurate must the ball be. It is evident that, were a ball so much larger than its fellows as not to deform sufficiently under its share of the load to permit the others to carry, that it would then not only itself have to carry more than intended, but would also transmit more than intended to the supporting surfaces of the races. If, on the other hand, the ball were smaller than its mates, it would be under-loaded or not loaded at all, and the others correspondingly overloaded. What has been said of variations in ball size, of course, applies similarly to variations from truth of outline.

All requirements will be met if the balls are true to shape within one ten-thousandth part of an inch and if all of the balls used in each individual bearing have a similarly small error in size. It must not be inferred that for materials of lower grade, larger inaccuracies are permissible. Were the load distribution the only factor, that conclusion might be justified; greater inaccuracy of size means greater deformation and therefore greater departure from sphericity and the substitution of too great a percentage of sliding for the rolling aimed at. Considerable initial variations from truth of shape have precisely similar results.

b Surface finish to a very high degree is also essential. What is usually considered a very good finish indeed may be characterized as totally inadequate. The recognition of grinding or polishing marks not only by the bare eye, but with an ordinary pocket reading lens condemns balls utterly; this is true of a bearing having long life under high loads and speeds. Oft repeated endurance runs, under conditions where the finish was the only variable, have abundantly proved this, at first unsuspected, fact. This was discovered while investigating an apparently inexplicable difference in lasting qualities. As life is too short for a try out under normal loads, overloads were resorted to; they demonstrated conclusively that the higher the finish, the better the endurance.

c The elastic limit should be as high as can be had. A limit of proportionality above the elastic limit is desirable.

d The hardness and uniformity of hardness throughout the mass of the ball to the highest attainable degree is essential.

e Correct knowledge and uniformity are more important than even these requirements of high elastic limit and hardness. It will not do to say that, though some balls of a lot may do better than others, the design may be based on the poorer ones. That would result in the better balls carrying more than their share of the load, much as and with the same bad effects described while considering truth of shape and size. Lower quality, provided it is uniform, can be allowed for. It will then merely affect dimensions.

Ball making machinery has arrived at a very considerable state of perfection; but balls within a limit of one ten-thousandth of an intended size are not yet being made without the sacrifice of other qualities. That is, however, not important beyond having some slight bearing on cost, since it is perfectly feasible to select and grade balls within the desired limit; but the hardware dealer's word for uniformity of size is not a safe guide; he is perfectly honest in throwing odd lots of ⅝-inch balls into one box and in thinking the customer who objects because they vary a half-thousandth, or even two, a "finicky crank."

Characteristics of Various Makes of Balls

An investigation was made into the qualities of various balls, with a view to fixing on the best make to use. Balls were tested for the quality of their material by determining their behavior within the elastic and proportional limits. This was done by mounting three balls on top of one another and attaching extensometers to the top and bottom balls. As the readings corresponded to the total compression of two balls, the actual deformation at each contact point was one-fourth of this reading.

Not only were the deformations measured under loads varying from 50 to 800 kilograms for balls from ⅜ inch to 1 inch, but the permanent deformations also were determined. At least two consistent sets of tests were carried out with each ball diameter, using a new ball for each set.

It is clear that, other things being equal, that ball is best whose permanent set is least with reference to the total deformation, i.e., the larger the ratio (permanent deformation ÷ total deformation) the better the ball. This ratio varies with the hardness and is therefore a convenient measure of the hardness. Six different makes of balls were tested; the deformations were most carefully determined at Cornell by Professor Diederichs, who was furnished with balls taken from a quantity bought in the open market. Of these balls three were of American origin, two of English, and one the D. W. F. German ball. For obvious reasons the names are not given, but in the diagrams the balls are marked *X*, *Y*, *Z*, *U*, *V*, *W*. The *X* is the D. W. F. Fig. 2 is a diagram in which the hardness of the *X* or D. W. F. ¾-inch ball is plotted. The curve will be seen to fairly average the readings. The relatively small variations may be reasonably attributed to observation errors.

Fig. 3 gives the plottings and averaging curve of the *Y* ¾-inch ball and also of the *X* for comparison. Figs. 4, 5 and 6 are similar records of the *U*, *Z*, *V* and *W* ¾-inch balls. In all of these there is much greater difference between the plotted readings and the averaging curves; near the origin, where the deformations under the lighter loads are smaller, a larger part of the variations may, no doubt, be attributed to observation errors than further along under the higher loads; after making due allowance for this it is clear that the relatively considerable variation in the hardness readings of all balls as compared with the small variation for the *X* ball is due to a lesser uniformity in the material, attributable to differences in chemical composition and heat treatment. Without taking up undue space by giving similar records of the various balls from ⅜-inch to 1-inch tested, it may be said that these all corroborated the testimony of the ¾-inch series shown.

Owing to the greater uniformity of the *X* ball, and also because that uniformity indicates it as best for ball bearings with the manufacture of which the author is connected, the averaging line of this *X* ball has been drawn in for comparison in each diagram. Inspection shows that it lies generally below the others; the lower, the greater the relative difference in hardness in favor of the lower curve characteristic. Only in Fig. 7 does the *W* curve show up better than the *X* for loads of 700 and 800 kilograms, while less so for loads below 600 kilograms.

One particular make of ¾-inch ball, the *Y*, showed a most surprising variation in hardness. In Fig. 8 the lower curve is the *X* of Fig. 2, the second is the *Y* of Fig. 3, and the upper is also a record of a *Y* ¾-inch ball of the same make as the *Y* ¾ inch of Fig. 3. This one upper *Y* ball is rather more than four times as soft as the other (lower) ball.

The range of hardness variation of different sizes and makes of balls was found to be instructive. Fig. 9 shows this for the six makes of 1-inch balls. The range lies in the cross-hatched area bounded by the upper and lower dash curves. For this

diameter of ball the variation is over 100 per cent. at 800-kilogram load and considerably greater under lighter loads. As the ball diameters decrease, the relative variation in hardness of different makes becomes less, as is clearly enough apparent from an inspection of Figs. 9 to 14, inclusive.

When these variations in quality are considered, it must cease to be a matter of surprise that such widely differing opinions as to the reliability of ball bearings are held. It may be remarked that the various balls tested all enjoy a good reputation. Makes of known poor grade were not tested, the advisability of adopting a different make of ball having been one of the objects of the investigation.

In the diagrams Figs. 9 to 14, inclusive, the characteristic of the various makes of balls have been drawn for a comparison of their relative hardness merits. In considering these relations, the greater weight must be given the characteristics of those series in which the hardness range is lowest on the diagram, i.e., the showing of Fig. 10 for the 7/8-inch balls is much more important than that of Fig. 14 for the 3/8-inch balls. One location of a characteristic near the lower range limit of Fig. 14 is much less important than such location in Fig. 10. Quantitatively this may be taken as follows: Under 800 kilo-

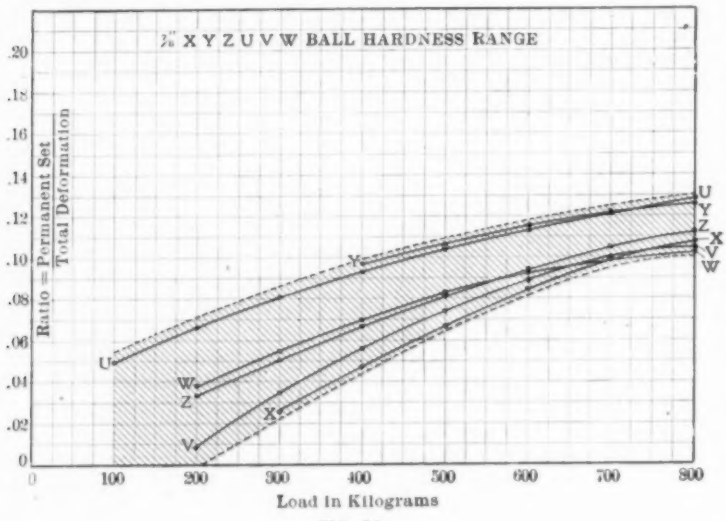


FIG. 10

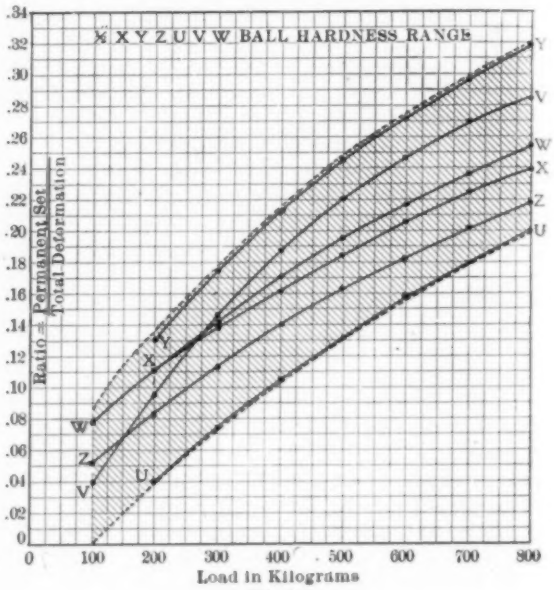


FIG. 13

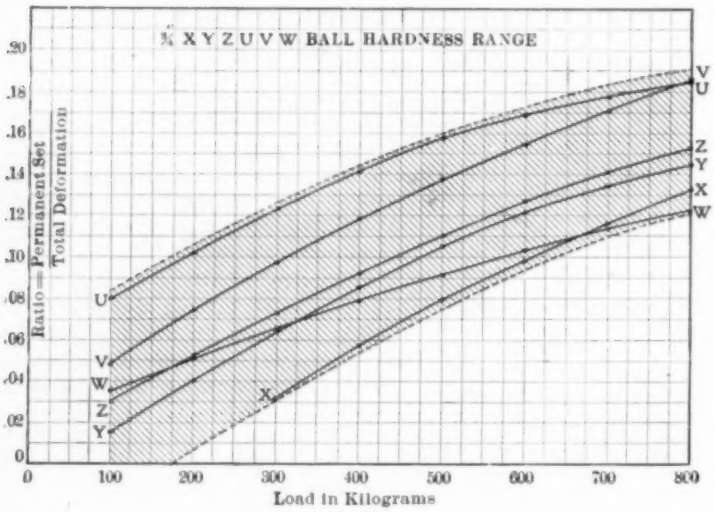


FIG. 11

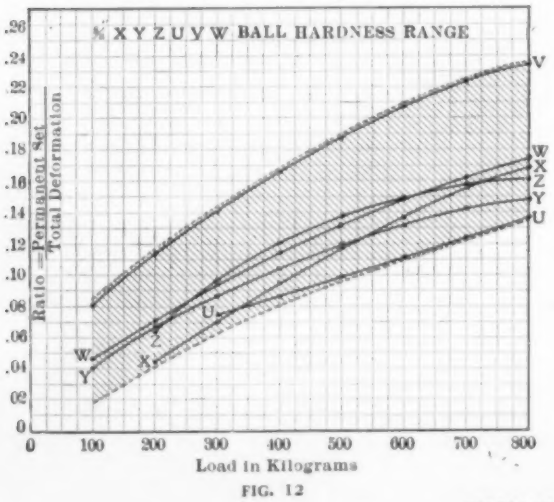


FIG. 12

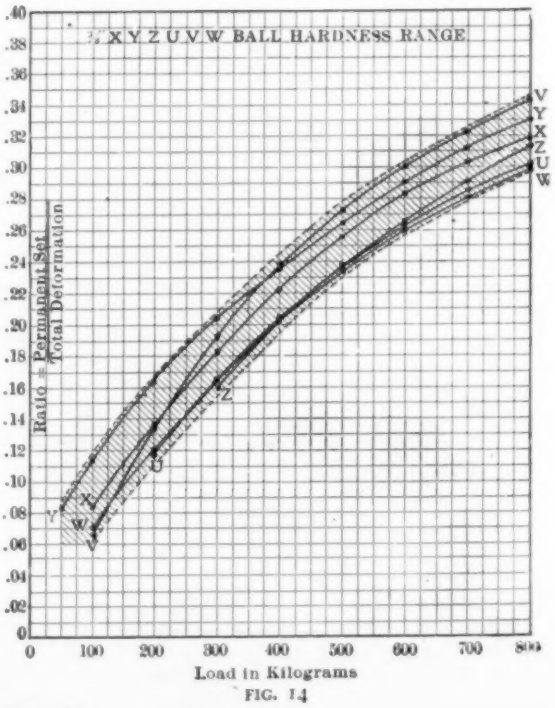


FIG. 14

DIAGRAMS OF BALL HARDNESS RANGE

grams, the lower range boundary of Fig. 14 is to the upper one as 0.296 to 0.346 or 1 to 1.16 (ratio of hardness scale at left). In Fig. 10 these figures and ratios are 0.100 to 0.130 or 1 to 1.30; which indicates that a similarly favorable location in Fig. 10 is about $\frac{1.30-1}{1.16-1} = \frac{0.30}{0.16} = 1.87$ times as valuable as in Fig. 14. The relative hardness merit works out first *X*, second *W*, third *Z*, with honors even for *U* and *V* and *Y* for the last place.

Surface Character

Micro-photographs of ball surface under a magnification of 35 diameters were made from balls ¾-inch in diameter. The finish ranges all the way from fine scratches to pittings and even gashes. In the order of merit balls *V* and *X* very decidedly rank the others. Unfortunately *V*, which ranks third, is last in hardness; for which lack the good surface cannot compensate. Ball *X*, second in surface finish, is first in hardness.

Grain Structure

Opinions differ as to validity of judgment based on the appearance of fracture surfaces. The leaning is, on the whole, toward a favorable consideration of balls that show the more uniform grain and more even fracture from the center to the circumference, as well as the finer grain. Balls were split by compressive loading in a testing machine, holding three in line at a time. The balls are the same of which surface photographs were made. Micro-photographs were made under an enlargement of 20 diameters at the edge, about half way in and at the center of each ball. In these photographs the *X* ball apparently shows the finest grain at all three places with *Y* and *Z* following. In this connection it is but fair to say that Professor Rankin, of Cornell, who made the various micro-photographs, considers that the *X* grain structure is coarser than the *W U* and *Z* and much finer than that of the *V* and *Y* balls. In his opinion, for balls of the same general composition, the finer grain structure accompanies the greater resistance to breakage. Grain structure merit is *U, Z, W, V* and *Y* according to Professor Rankin, while to the author the photographs seem to indicate *W, Z, U, V* and *Y*.

Microstructure

Magnifications were made of 150 diameters and 800 diameters. Professor Rankin considers that no definite microstructures have been developed because the steels have not been held at a high temperature long enough, and that the originally definite crystal boundaries have been confused by imperfect annealing and slow cooling. Analysis shows a trace of graphite carbon in all but the *X* which shows rather more carbon in that state.

The sections show generally a large proportion of martensite, with the balance made up of austenite showing parts of cementite. The martensite is 92 per cent. for the *W*, 87 per cent. for the *Z*, 83 per cent. for the *Y* and 82 per cent. for the *X*, 81 per cent. for the *U*.

(To be continued.)

Annealing High-speed Steel

By Ethan Viall

From the varied and somewhat weird experiences in the annealing of high-speed steel, as related by contributors to the American Machinist and other papers, it is very evident that a hazy idea exists in general as to the proper treatment. In order to help clear this up, I wrote to eight of the most prominent makers of, or dealers in high-speed steel, asking what they considered the best way to anneal their particular brand. All but one courteously sent instructions.

The answers I received are given below,

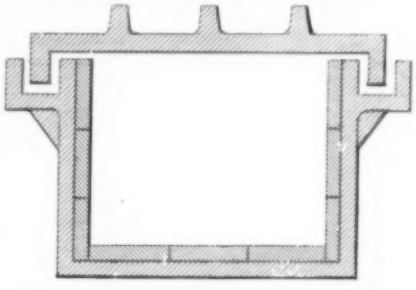


FIG. 1. CAST IRON BOX FOR ANNEALING

all information which they sent, not pertinent to the subject, being omitted for the sake of brevity.

Styrian Steel

From George Adams, with Houghton & Richards, Chicago, agent for Bohler's Styrian rapid high-speed steel:

"Cover with powdered charcoal and anneal in hermetically sealed boxes for about four to six hours (according to size) at a temperature of 1800 degrees to 1900 degrees Fahrenheit (1000 degrees Centigrade). Allow the boxes to cool slowly."

Midvale Special Steel

F. W. Sager, Chicago, agent for the Midvale Steel Company's special self-hardening steel:

"Place in a box equal parts of slacked lime and charcoal; slowly and thoroughly heat to a light cherry the piece to be annealed; at the same time heat a piece of scrap metal of any kind to the same color and first place it in the box, then place piece to be annealed on top of scrap piece and cover with contents of box. Do not remove till perfectly cold."

Sanderson Steel

John A. Mathews, of Sanderson Brothers' Works, Syracuse, N. Y.:

"The steel can be annealed in very much the same manner as tool steel, although the initial heating should be a little higher, for example, about 850 degrees Centigrade (1562 degrees Fahrenheit), and the cooling should be considerably slower than is necessary in order to obtain the desired softening for any plain tool steel. The slower the steel is cooled, the better, after it has once been heated to a good cherry-red heat and held there, for an hour or two."

Crescent Steel

G. F. Ziv, agent of the Crescent Steel Works:

"It is necessary to heat some up to a nice bright red heat and hold same for about six hours; then bury in charcoal or dry ashes until cool."

Capital Steel

E. B. Lapham, of the Geo. Nash Company, agents for Seebohm & Dieckstahl's Capital high-speed steel:

"If only a small piece of steel or a single tool is to be annealed, this may be done by building up a fire-brick box in a blasksmith's fire, placing the tool in it, covering up the top and heating the whole after covering with coke, leaving it to cool down over night.

"Another quick method is to heat the tool to a full red heat, bury in sawdust, lime, sand or hot ashes and allow to cool gradually.

"Quick, but only partial, annealing can be effected by heating steel to a dull black heat, then plunging it into hot water.

Thorough Annealing

"If large quantities of steel are to be thoroughly softened, the annealing should be done, if possible, in a muffle furnace, coal, gas, or oil fired, the pieces being placed in a cast-iron box, the interior of the box being lined with fire bricks, and the lid fitting into a groove, as shown in Fig. 1, the groove being filled with sand to exclude air.

"The whole box should then be heated to just below the critical point for high-speed steel, 900 degrees Centigrade (1652 degrees Fahrenheit), and kept at this temperature from one to four hours, or longer if necessary, according to size of the box and the quantity of steel being annealed.

Cooling Gradually

"The box should then be allowed to cool down gradually, and should not be taken out of furnace until practically cold.

"Great care should be taken not to soak the steel (i.e., keep hot for too long a time).

"As soon as the heat of 900 degrees Centigrade (1652 degrees Fahrenheit) has been reached and has penetrated through the box and contents, the firing should be stopped. Exclude air from high-speed steel when heating for annealing."

Novo Steel

Hermann Boker & Co., agents for Novo steel:

"Please note that in annealing, great care must be taken not to heat steel too quickly, as our experience has been that too rapid heating in the annealing will cause the steel to crack.

"To anneal thoroughly, it should be packed in an air-tight cast-iron box, receptacle or pipe, well packed with lime, and put into a furnace and heated up to a good red heat and should be kept at that heat all the way from 12 to 18 hours, the time depending entirely on the size of the tool to be annealed.

"The size ½x1 inch requires fully 12 hours at a full red heat, and the more slowly the cooling off is done after this heating, the softer the steel will be.

The Best Method

"The best method is to let the well packed steel cool off by itself in a slowly dying out furnace, or you can take the box or receptacle in which the steel is packed, embed it in lime or hot ashes, and allow it to cool off slowly in that manner.

"Your attention is particularly called to the fact that while the steel is undergoing this annealing process, the steel, not only in the cooling off after having been kept in the furnace for 12 to 18 hours, should be excluded from air, but also the heating up of the steel, or the annealing heat, while in the furnace, should be done under an absolute exclusion of air."

Cyclops Steel

Chas. Burgess, Cyclops Steel Works, Titusville, Penn., makers of Burgess' high-speed steel:

"Mix three parts common sand and one part lime, then take a piece of pipe say one or two inches larger in diameter than the body of steel to be annealed. Plug one end of the tube with fire brick or clay, then stand tube on end and put in one or two inches of the sand mixture, after which the steel should be put in, and the sand packed well around it, being sure to keep steel from the side of tube. The other end of tube should then be plugged.

Hotter Than Ordinary Steel

"The furnace should be about twice as hot as you would have it to anneal ordinary tool steel, and it should be kept at this heat say two or three hours, according to the bulk of the steel. It should then be allowed to cool down very slowly.

"A very good time is to put the tube in when through work on Saturday, and allow it to remain in until ready for work Monday. If it is necessary to take the tube out before cold, it should be put in a warm place and covered with ashes or dirt, so that it will cool slowly."

Where the Instructions Vary

As will readily be seen from these letters of instruction, the time and amount of heat vary considerably, and what is proper for one brand would probably have no effect on another. Some make no mention of the importance of the exclusion of air while others, Boker particularly, emphasize it.

As the showman said: "You pays your money and you takes your choice;" but as for myself I have found the method I gave in a former number entirely satisfactory for my own use.

A Multiple-spindle Tailstock for Turret Work on an Engine Lathe

By Oscar E. Perrigo

Many small and moderate-sized shops cannot afford the expense of a turret lathe, while other and larger shops cannot afford the number necessary to do

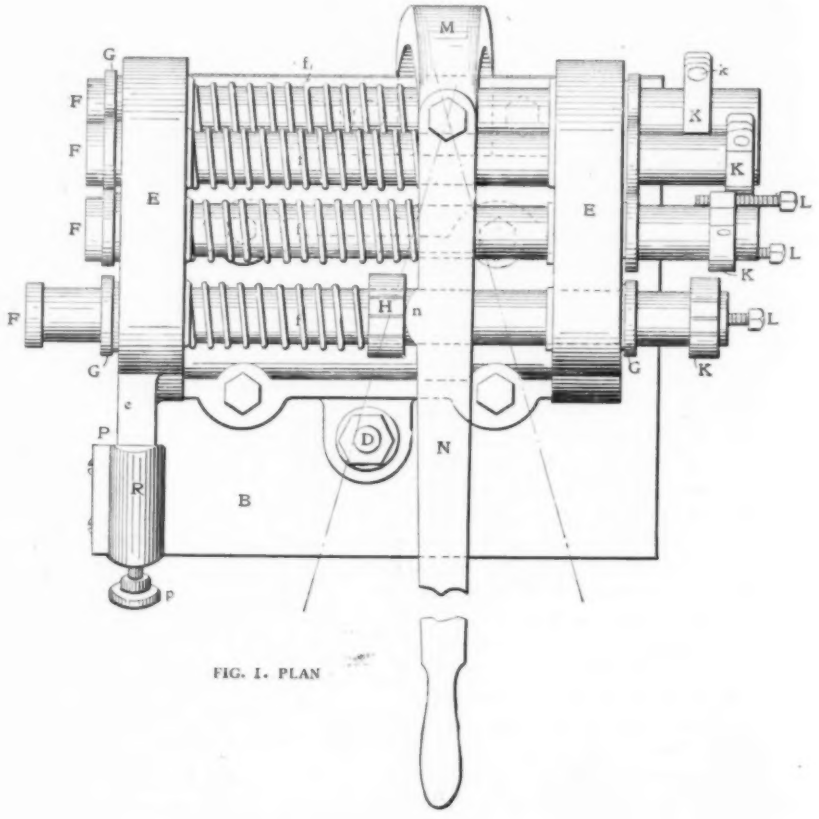


FIG. 1. PLAN

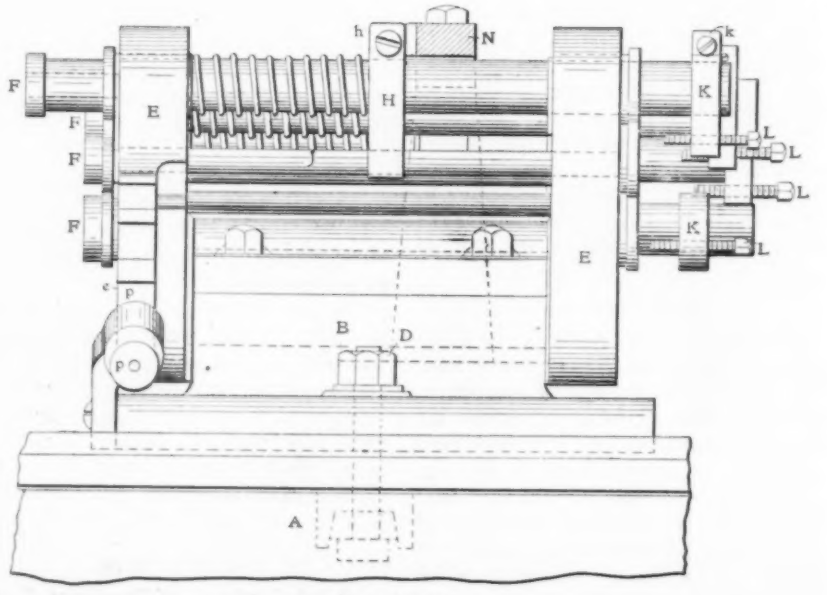


FIG. 2. SIDE ELEVATION

A TURRET TAILSTOCK FOR THE LATHE

all of their work for this class of machine tool. Various good and well designed turret attachments are made for use on engine lathes, but are expensive. Hence, it would seem that an economical attachment would be very useful and acceptable. All the more so, when it is so designed as to be conveniently made in the shop where it is to be used, with the aid of the usual machine-shop equipment.

The design presented herewith meets most of the usual requirements for such an attachment. The original design was for a device for doing comparatively small

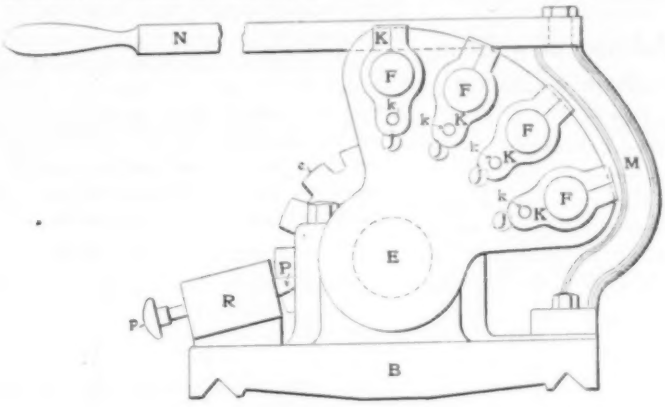


FIG. 3 Rear Elevation

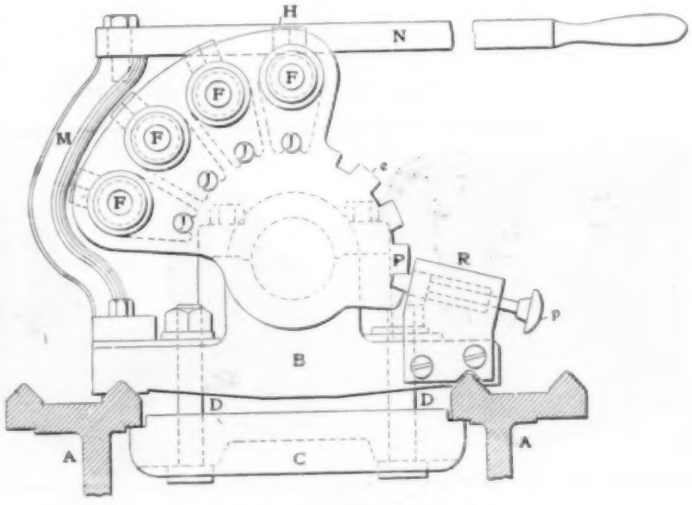


FIG. 4 Front Elevation

A TURRET TAILSTOCK FOR THE LATHE

and accurate work. The sliding spindles were preferred to the usual turret form, as it was thought that correct alinement could be more easily obtained and kept in this manner. The results have been satisfactory with attachments of various sizes, on different classes of work and in several different shops where they have been used. It is illustrated in the accompanying engravings, in which Fig. 2 is a side elevation, showing the attachment applied to a 20-inch swing engine lathe. Fig. 1 is a plan view to show more particularly the hand lever for operating the spindles. Fig. 4 is a front elevation showing especially the locking device and the relative positions of the spindles. Fig. 3 is a rear elevation showing stop clamps and adjusting screws on the rear ends of the spindles.

The construction of the attachment is as follows: Upon the V's of the lathe bed *A* is fitted the tailstock base *B* in the usual manner. It is clamped at any desired point by the strap *C* and the holding-down bolts *D D*. Journaled in the base *B* and parallel to the center line of the lathe is the spindle carrier *E*. This is cast in one piece with the journal in the center and housings at the ends, as shown. This journal is accurately fitted in its bearing for its entire length, and is held down by a suitable cap with four cap screws.

The housings are drilled and fitted for four spindles *F F F F*, 1⅜ inches in diameter and 18¼ inches long. They are all equidistant from each other and from the center of the journal bearing. The holes for these spindles are bored larger than the spindles, and reamed to a taper. They are tapped with a fine-threaded tap, and thin taper bushings *G G* are fitted to them. These bushings are finally split to permit of taking-up wear, thus insuring a firm bearing and a good fit on the sliding spindles. By this construction the correct alinement of the spindle is constantly maintained. The manner of fitting up these parts will be explained.

The sliding spindles *F F F F* are reinforced at their front ends by an increase in diameter of ¼ inch for a length of ½ inch. They are bored and reamed for a standard taper-tool shank. A set-screw may be put in the reinforced portion if the tools used are of such a form as to require it, in order to secure them firmly in position. Near the center of each spindle is adjustably fixed a clamp guide *H*, the lower end of which is grooved to fit the guide rods *J J J J* and to slide upon them. This is to prevent the rotation of the spindle. The guide clamps *H* are split and provided with a clamping screw *h*. On the rear end of each spindle is a somewhat similar clamp *K*, which is adjustable and has a clamping screw *k*. It can be fixed at any point on the spindle. In the lower ends of these clamps are the adjusting screws *L L L L*, to adjust the travel of the spindles when the tool carried in them is making a cut.

Fixed to the rear side of the base *B* is the curved bracket *M*. To its upper end is pivoted one end of the operating lever *N*, which has formed upon its edge and directly over the sliding spindle in the operating position a curved portion *n*, which rests against the guide clamp *H*, as shown in Fig. 2. The lever *N* has a range of motion as shown by the radial lines. Its purpose is to force forward the sliding operating spindles. Upon each of the spindles, and between the clamp guide *H* and the front bearing in the spindle carrier, is an open helical spring *f*. Its purpose is to force the spindle back to its "home" position after the cutting operation has been completed.

By the swinging movement of the spindle carrier *E* upon its journal bearing, either of the spindles may be instantly brought into an operative position by a single motion after the release of the indexing device. To retain the spindle securely in its position in line with the main spindle of the lathe, the index segment *e* is formed upon the front housing of the spindle carrier. In it are milled four grooves with slightly inclined sides. The index plunger *P* is fitted to these grooves and is held in its place by the usual helical spring within its casing *R*. This plunger is handled by the knob *p*.

In the construction of this attachment care must be exercised on several points in order to make an accurate and successfully working device. Among these are the following:

First, the base *B* must be scraped to an accurate fit on the V's of the lathe bed.

Second, the journal bearing of the spindle carrier must be fitted to an accurate bearing by hand scraping.

Third, the slots in the index segment *e* must have both their sides of the same

inclination, about 2 or 3 degrees to the radial line. Their width need not be particularly accurate, for the wedge form of the index plunger will cause its sides to come to a fair bearing if accurately fitted across its entire face, as it should be.

Fourth, the spindle holes should be carefully laid out on the housings of the spindle carrier and drilled considerably smaller than their finished size. After the device is clamped in place on the lathe bed, the holes are bored with a boring bar held on centers in the lathe. These holes should then be reamed with a taper shell reamer on an arbor similarly held, and tapped with a taper shell tap in the same manner. The tap should have a fine thread, say 16 to an inch for a 1½-inch tap. Instead of a shell reamer and tap, these may be made solid, if shank is long enough to reach through the two holes. The front holes are machined and the tool turned "end for end" for the others.

Fifth, the taper bushings *G* should be bored slightly smaller than the spindles, then threaded and fitted to the tapped holes, so that when screwed into them quite tightly the shoulder will lack 1/16 inch of coming up to the face of the spindle carrier. The small end should project slightly on the opposite side. They are then bored out in place with the boring bar. The diameter of the hole must be the exact diameter of the outside of the spindle. The bushings are then removed and split with a thin saw, say 3/64 inch thick.

Sixth, the spindles are put in place, the split bushings are screwed up tightly, the clamp guides *H* are adjusted to prevent the spindle from rotating, and the holes in the front end are drilled and reamed to a standard taper. The tools are held in the lathe and care is taken to make them run perfectly true.

Any of the ordinary turret-lathe tools may be used in this attachment, such as drills, reamers, taps, dies, box tools, etc. The tool post in the tool block or in the compound rest may be used for a cutting-off tool or a forming tool. In this way the number of operations may be increased. With a speed lathe, a slide rest may carry the additional tools when needed. If this useful adjunct is not available, a simple cutting-off slide similar to those provided for small turret lathes may be made. In this manner a speed lathe may be arranged to turn out as much work as a hand turret lathe of the same number of tools.

Fitted to a bench lathe, this attachment is very useful and economical on a large variety of small work.

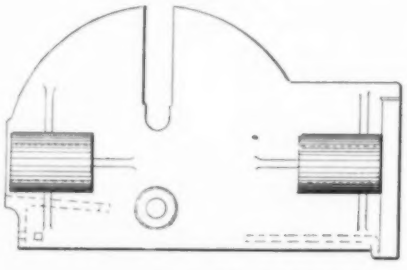
The operation of this attachment is apparent from its construction. The desired spindle is brought into the operating position by releasing the index plunger *P* and throwing the spindle carrier *E* forward or backward until the index plunger enters the proper groove. The tool is forced forward on the cut by the hand lever *N*. The cut having been completed, the lever is allowed to return to its original position by the action of helical spring *f*. The next operation is performed by bringing another spindle into the operating position, and so on.

While the device illustrated was designed for a 20-inch swing lathe, the same design in essentials is adapted for lathes as small as 5-inch swing and has been so used with success.

Machine Molding of a Chaff-cutter Mouthpiece Casting

By George Buchanan

The half-tone, Fig. 1, is from a photograph taken from a couple of castings made on the molding machine. The number of these pieces molded by hand from an iron pattern and turn-over board averaged about five per day. The metal pattern used was in every way the best of its kind, and the turn-over board was cut away to conform with the parting line of the pattern, so that any advantage obtained by the use of the molding machine may be taken as belonging to the machine itself and not to any superior get-up or finish on the molding-machine patterns.



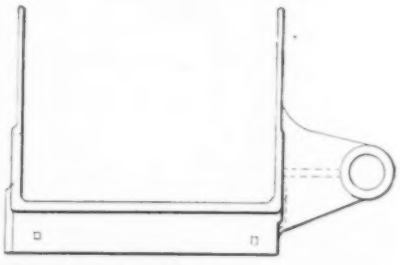


FIG. 2 AND 3 SIDE AND FRONT ELEVATIONS

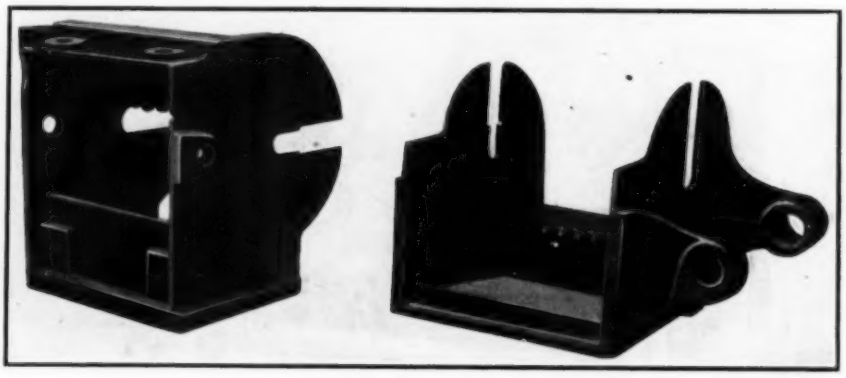


FIG. 1. CHAFF MACHINE MOUTHPIECE CASTING

This mouthpiece casting will be familiar to users of chaff-cutting machinery. It is, in fact, the principal casting for this type of machine. The price at which these machines are sold is so low that only the best equipped shops can hope to compete successfully in their manufacture; while the large number of sizes, ranging from the smallest hand to the large power machines, and the changes constantly taking place, calling for alterations in the patterns, make it an extremely difficult matter to keep abreast in the matter of production and at the same time leave a margin of profit for the maker.

The type of molding machine used for this piece is the "stripping plate." No other machine gives such uniform results where deep vertical patterns are concerned. Two machines are required: a 10-inch draw for the bottom or drag part of the mold and a 5-inch draw for the top part or cope.

All stripping plates, stools and patterns are of metal—cast iron, brass and babbitt—and the various pieces which go to make up the mounting of the patterns are all carefully lettered and marked, so that the machine can be dismantled and other patterns fixed as occasion requires.

Making the Patterns

Many patterns can be fitted on the stripping-plate machine with comparatively little labor and with little or no labor on the pattern itself, while others require special patterns. The mouthpiece casting is of the latter kind, and the patterns are made especially for the machines.

A side and front elevation and a plan of the piece are shown in Figs. 2, 3 and 4. When making the patterns from the master pattern, all horizontal surfaces are stopped off, such as *A*, *B*, *C* and *D* in Fig. 4, while all vertical parts are extended below the parting line of the pattern to provide guides for the stripping plates and to aid in attaching the pattern to the carrier in the machine. This applies to patterns for both the drag and the cope. The

various parts of the patterns which are stopped off are re-formed in the shape of stools, internal stripping plates, etc.

A glance at Fig. 5 (which is a plan of the bottom part mounted on the machine) will give a clear idea of the stripping of this piece. The part shown in section is the only moving piece, and sinks by a turn of the lever to a position below the horizontal surfaces, thus leaving all corners stripped clean to insure a clean lift.

On Fig. 6 (a plan of the pattern A machine for the top part of mold) the pattern is cut away, leaving two strips *E* and *F* attached to the pattern. As in Fig. 5, the sectioned parts move. All other surfaces are permanently fixed. These two pattern

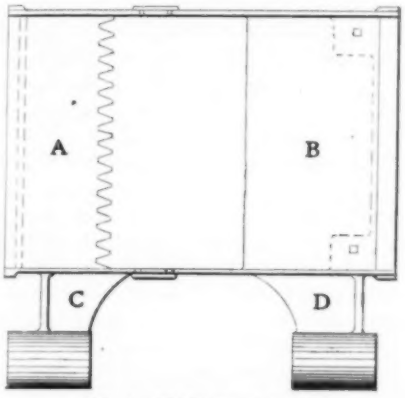


FIG. 4. PLAN OF CASTING

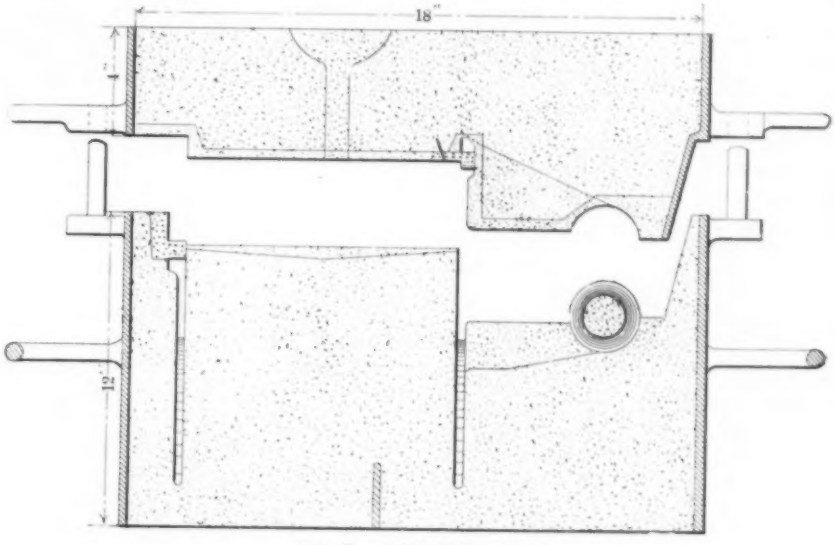
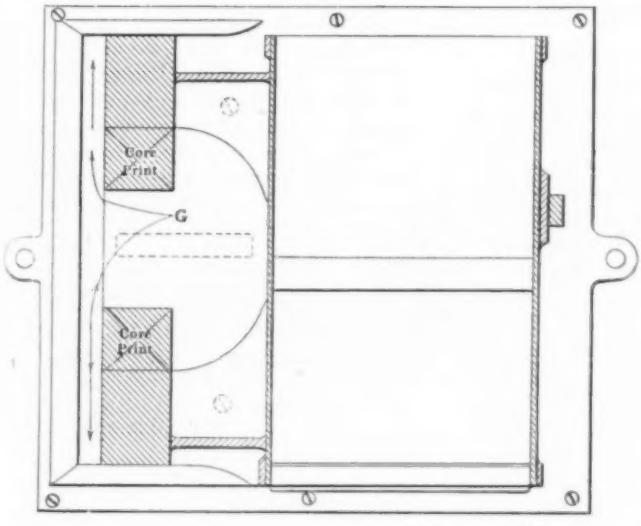
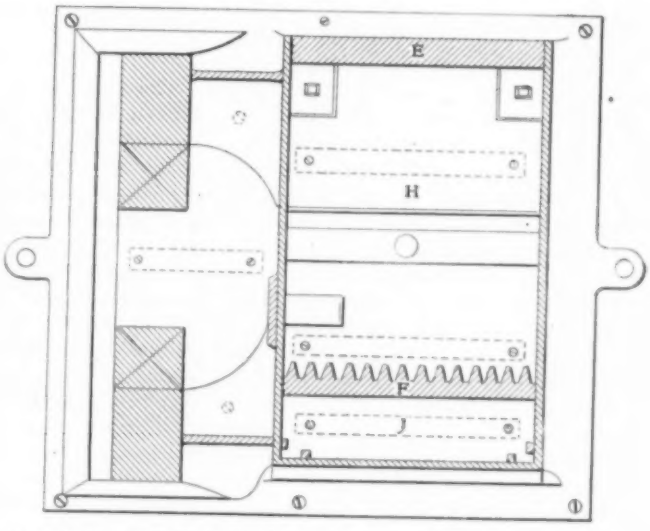


FIG. 7. SECTION OF MOLD





FIGS. 5 AND 6. PLANS OF MACHINES SHOWING STOOLS

castings are filed up and finished to size, using the existing metal pattern—which was used for floor molding—as a guide to the various and minor alterations which have been constantly taking place in the patterns to keep down fitting costs, etc. The parts required next are the stripping plates.

The Stripping Plates

It is not usual to make patterns from which to cast stripping plates, although in some places straight-shaped patterns can be used to advantage. In the present instance, however, the stripping plates are best made by making a complete mold in a flask large enough for the forming of the stripping plate, with the joint carefully made. The mold having been parted, another top part is rammed up on the same drag, and lifted off and placed on its back. On this top part a drag box is placed and rammed up, and the whole rolled over and the top lifted off. We now have two complete molds with parting lines as nearly alike as possible.

The flask pattern is next set on the drag and the sand made up around it ½ inch high. This is the thickness of the stripping plate. This is done in both molds and a line is carefully marked on the parting about ⅜ inch back from the pattern.

The pattern of the mouthpiece having been carefully drawn, the deep parts of the mold are filled with parting sand and a lead making-up piece ½ inch thick is used, thus making up the sand ½ inch high and ⅜ inch larger than the space occupied by the pattern. The lead piece is useful, as it can be readily bent to shape. The making-up edge is also V-shaped about ⅜ inch. This is to form a support for the babbitt which is afterward run into the ⅜-inch space between the pattern and the stripping plate. Holes are also drilled close to the edge of the stripping plate into the V about every inch, to help hold the babbitt.

The stripping-plate molds are formed in exactly the same manner, except that the whole of the up joint for the bottom stripper is stopped out, leaving only the strip of lead joint around the outside of the plate. The part stopped out is shown at *C* in Fig. 5. The plates are cast, carefully dressed, tried together and fitted until their faces match snugly. Both plates are next drilled together for the flask guide holes. A flask part or a special jig is used for this purpose. The stripping plates are next placed face to face and are located by means of the pins and holes. The up joint which was stopped out in the drag plate is now run in with babbitt. This gives a perfect joint at an awkward place. The stripping plates are now ready for having

the babbitt run in. Quarter-inch holes are drilled close to the edge of the plates into the V mentioned before.

Locating the Patterns in the Stripping Plates for Babbitting

No doubt several methods are in use for correctly locating patterns in their respective strippers. The following has been found to work well for the class of crooked-joint work described, but modifications of this method, depending on the patterns, are necessary in many instances.

A molding flask which is made for the machine-mounted pattern is placed on the floor and a mold made in it from the metal pattern—using, however, the drag-part stripping plate to form the joint. After the mold is turned over, the stripping plate is lifted off and the joint made close to the pattern. It should be remembered that up to the present the stripper comes to within only ⅛ inch of the pattern. The top box is next rammed up, lifted off and placed level on its back on the floor. The loose metal pattern is carefully drawn from the drag mold and the machine pattern placed in the cavity it occupied. The stripping plate is again placed on the joint and the babbitt is poured into the space. Both patterns and strippers should be warmed before pouring, as the metal will fly if this is not done. The cope, which is on its back, is treated in exactly the same manner as the drag. Both are run at the same time. The joints are dressed after the patterns have been carefully knocked out of their respective strippers, and the internal strippers *H* and *J*, Fig. 6, are formed in babbitt by again making a mold from the loose pattern and placing the machine pattern in its cavity and pouring in the white metal about ½ inch thick. If care is taken these operations need be done only once and no failures need occur. Many parts can be made perfect only by the taking of a trial mold. By this means the hight of the stooled parts can be nicely adjusted, and any parts of the joint which show a crush can be trimmed until they are right.

Fig. 7 is a sectional view of the mold, cope and drag. Both these parts lift clean from the machine without using a single gagger. The castings are much more uniform, both in the thickness of the two vertical ribs, which is important, and also in weight, while the saving effected by the use of the machine is 75 per cent. of the whole cost of molding. Five per day were made by hand and 20 are made by the machine.

Considerable interest is manifested in a process that has been discovered by which alcohol may be distilled from cactus leaves. The cactus attains a growth of several feet in height, and the leaves are broad. The process of distillation is said to be simple and comparatively inexpensive, and it is claimed that experiments made have proved quite successful.

The Premium Plan

By W. L. Hardy

I have been an interested reader of the various articles that have appeared from time to time regarding the premium system, and have noted the fact that practically all of these articles are written from the standpoint of the foreman or time-setter, and that very little has been written from the standpoint of the men who do the work.

The avowed object of the various premium systems in use is to cheapen product and, strictly speaking, they are more or less clumsy subterfuges for the direct piece-work plan, which, were it not for the ingrained hoggishness of people, would be the ideal method of paying for work.

The reasons why the latter system has fallen into disrepute are not far to seek. In the shop the tendency of piece work is to bring to the front a set of men who have a large amount of horse in their make-up, and who are able to, and do, set a pace on their jobs that physically weaker men are unable to follow. The shop management on its part assumes the right to cut the piece price arbitrarily whenever it thinks the man is making too much money—in other words, it wants the man to increase his output without any corresponding increase of pay, and in time no one will undertake to make the piece at the price the shop offers.

Indirect Rate Cutting

This rate cutting is done very often indirectly in the furnishing of inferior stock or machinery. This is often very flagrant in the matter of castings; a rate is set for machining a certain casting, and since the shop has no interest in the matter beyond getting its finished work, proceeds to run in the cheapest casting that it can get. The man soon finds it impossible to make his rate of pay, as a few lumps or blow-holes will make a great difference in the time required to finish the piece. The Halsey premium system obviates this objection, as it makes the shop directly interested in the saving of time on the work, and its interest lies in furnishing proper facilities for doing the work in the least possible time.

To my mind the two rocks that lie in the way of any piece-work system, direct or indirect, are the rate setting and the rate cutting. It ought to be obvious to anyone, yet it does not seem to be to everyone, that (1) a man must see enough advantage in the prospective increase of pay to make it worth while to put forth the increased effort necessary to earn it; (2) there must be enough stability about the contract to insure to the man that he shall reap at least some of the fruits of his inventive ability in thinking out new tools or processes that shorten the time on a given piece, for as soon as he puts his ideas into practice they are appropriated by the shop, and are very often used as a pretext to cut the rate.

The Serious Objection

Just here, I think, will be found the most serious objection on the part of the man in the shop to any piece-work system. One type of man thinks that he does not get enough of the saving in the cost per piece, and the intelligent man knows that it is of little use for him to rack his brains for ways to increase his output, when in the end he is only going to make himself work harder to make his day's wages, or perhaps enable some husky, handy man to crowd him out of his job.

I have no suggestion to offer regarding rate setting beyond that of using care that this shall be fair to all concerned and shall offer sufficient inducement for men to increase their earnings; but I do suggest that, the rate, once set, *shall be adhered to for an agreed length of time or for a stated number of pieces.* In other words, make a direct contract with the man that the rate shall hold good for either one or more years, or until a certain number of pieces shall have been completed, and also that the rate shall not be cut when the improvement in the process has emanated from the man doing the work.

This last, I imagine, will be a bitter pill for a good many shop proprietors to swallow; for I note that in most cases as soon as a man goes to work in a shop he is thought by the management to have become a part of the plant, the same as one of the machines. Where this view is held, or where it is the settled policy that machinists may not earn more than 30 cents per hour, no premium or piece-work system of any sort will ever be much of a success, and the installation thereof will be a waste of time and money.

The Japanese have already built a railway on the southern part of the island of Saghalin, which part was assigned to them by the treaty of Portsmouth. There are coal mines on the island. Under their protectorate of Southern Manchuria extensive shops have been built at Mukden, intended, it is said, for building new carriages and locomotives, as well as for repairs.—*The Engineer.*

Few industries have made greater progress in recent years than the electrolytic refining of copper. In a commercial sense the process is scarcely more than 10 years old, but, as matters stand today, more than half of the copper on the market is refined by the electrolytic process. In addition to being slightly cheaper, electrolytic copper has the advantage of being, as a rule, purer than other copper, the result being that makers of copper alloys can obtain the results desired with greater certainty than formerly.

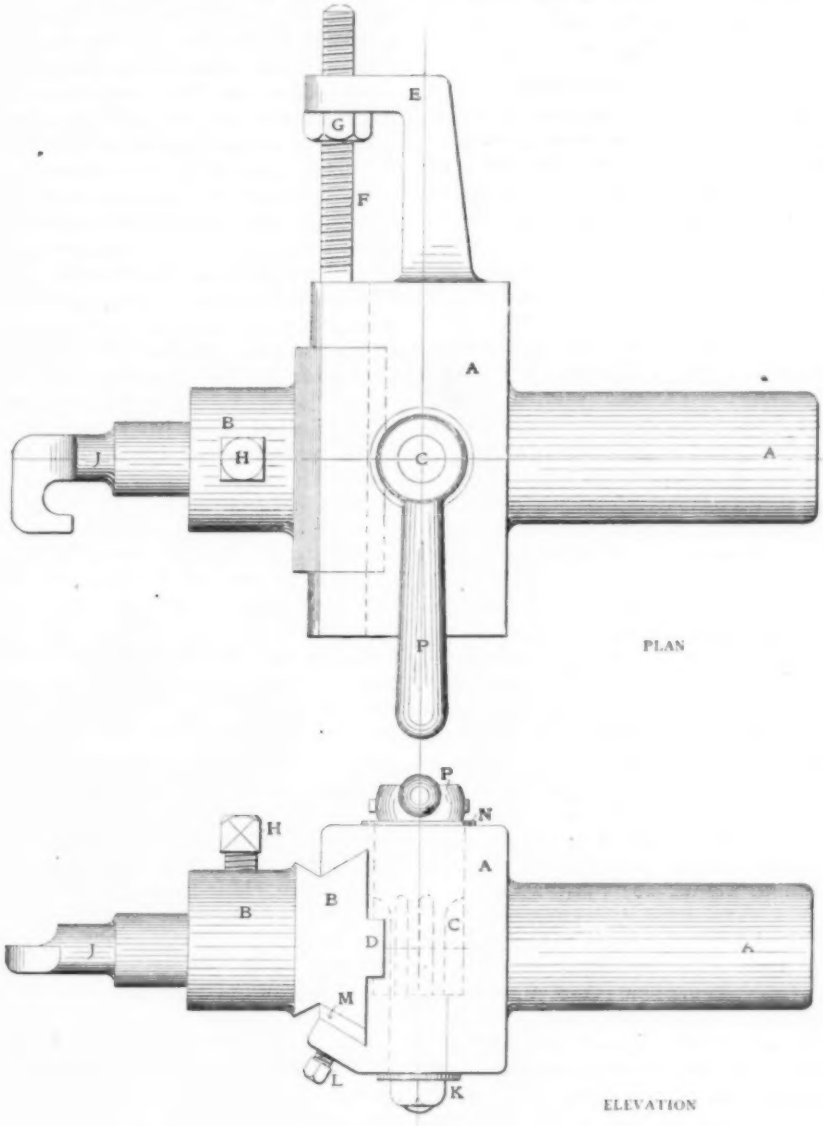
Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Cross-sliding and Recessing Tool for the Turret Lathe

The sketches show a cross-sliding and recessing tool, which we find very useful for cutting a recess at the back of a shoulder, on work which we usually do on a capstan lathe.



A CROSS-SLIDING AND RECESSING TOOL FOR THE TURRET LATHE

A is a malleable-iron casting, turned on the shank to fit the holes in the capstan, and planed out on the front to receive the forged-steel cross-slide *B*, carrying the cutting tool *J*, which is made out of round steel. *C* is a steel bar 1 inch diameter with a pinion cut on it, shown dotted, which operates the slide *B* through the rack *D*, which is cut on the back. *P* is the operating handle; a star wheel can be used instead if preferred. *N* is a thin steel washer; *K* is a nut screwed on the reduced end of *C*, for securing the latter firmly in position. *M* is the steel gib, and *L* shows the slide-adjusting screws. *H* is the screw for securing the cutting tool. *E* is a light projecting arm cast solid on *A*, acting as a stop. The ⅜-inch screw *F* passes through its slotted end and is screwed into *B*. The stop nut *G* can be adjusted to suit requirements.

The tool is very sensitive, and with the stop can do very accurate work which would otherwise require to be turned around, and necessitate another operation and consequent loss of time.

——, England. J. GREEN.

"Laboratory" vs. "Shop" in Technical Colleges

A few years ago one of our leading technical colleges gave up the name of "shop" and adopted that of "laboratories." It brought out some criticism and a brief argument in your columns. In looking through the back numbers of the AMERICAN MACHINIST in quest of another matter, I ran across an article at page 74, Vol. 27 (1904), Part 1, which I believe concluded the discussion at that time. It may seem strange to renew a subject that was threshed out so long ago, but it is possible that those who have had experience with the change may have something to report as a result of that experience. It is also possible that some, like the writer, were not in a position to discuss the subject then, but are now. For myself I think now that the wrong man got in the last word in the previous discussion.

THE "LABORATORY" IDEA

The proposition was about like this: The old way of teaching the arts of wood-working and iron-working by what may be called the natural method, that is, where each student worked by himself and in a measure felt his way, was to be superseded by the "laboratory" method, which we were told was a method by which each and every student received minute instructions as to what was to be done and then was required to do the same thing, in just the same way. The entire work of a craftsman, say a machinist, was to be analyzed, and, as the result of the analysis, divided into a comparatively small number of steps. The student having been shown how to take each one of those steps—once—and then having taken each one of those steps—once—was at once pronounced fit to direct other men to take those steps in our shops, and to decide what those steps should be.

OBJECTION TO USING THE WORD "LABORATORY" IN THIS CONNECTION

My first objection to this new order of things is that I do not believe that this should be called a laboratory system at all. A laboratory is a place for experiment, for research. This method allows no ex-

periment, no research. It distinctly states that no time shall be wasted by a student in doing anything original, nor does it allow him even to plan out his work in any way.

Criticism of the So-Called "Laboratory" Method of Instruction in Shop Work

But without regard to the name, let us consider what these young men want from the schools; and since trade schools are in my line, let us enlarge the scope of the argument to take them in too. Both technical students and trade-school students want to learn something which will enable them to earn more pay. In that they are agreed. The technical man expects to make his pay by brain work, the trade-school man expects to make his by manual dexterity coupled with brain work. They both need their brains developed then. Brain development means an enlargement of the capacity to think for oneself. Independent thought, initiative, thus mean money to both. You cannot make a boy think for himself unless you refuse to think for him; and that is just where the so-called laboratory system falls down for both kinds of schools.

The Student Should Become Used to Depending upon Himself

Parrot-like work, the mere doing of something in imitation of somebody else, can be taught anywhere, any time and in almost no time. It is being done in every shop in the land. It produces specialists, men who can operate one machine, or perform one set of operations. If a boy will be satisfied with this as his goal, he can get into almost any shop and be paid while he is learning; when he is through, he is just as well off as the student who has done the same thing. But that is not what either technical or trade-school boys are after. It is not worth their while to spend time and money on anything so elementary as this when these elementary things can be worked in with the fundamental principles just as well.

Since the time of the discussion referred to, I have had a chance, and have been glad to take advantage of it, to watch the workings of the natural system and, to a slightly less extent, of the laboratory system (so called) long enough to come to a pretty decided opinion as to their workings.

A Case from Nature

A pair of untutored, old-fashioned robins made their nest near my house last year. Not being up on the "laboratory" method of instruction, they went in the most crude and unscientific way possible at the teaching of their young to fly. The old birds fluttered around the nest for a while, calling to the young birds to come out and see how warm and nice the air was. The young fellows did not take the hint, so one of the old people went in and pushed them out of bed. Now by the "laboratory" method they should have had a system of overhead ropes and straps and things so as to hold them up till they learned how. The little birds made a desperate attempt to get down right side up, and the first thing they knew they were flying; not very well, to be sure. They missed by a few odd thousandths the branch the old gentleman was sitting on, but it was a fair job anyway. Now if there is any "laboratory" system that will do a quicker job than that I should like to know of it. Those little birds had it in them to fly, and they flew when they had to. Our boys have got it in them to do mechanical work, or if they have not they ought not to be taught it, and if they have to do it they can and will.

Learning from Failures

The man who uses the natural system gives his boy a job and some general instructions calculated to keep the boy from literally killing himself or blowing up the whole shop, and then leaves him till he has something to show. The boy who does it wrong gets the most instruction and learns the most, because it becomes more firmly fixed in his mind; then we none of us really know how to do a thing till we have tried a few of the wrong ways. That is experience. A man who has never been allowed to make mistakes has had no experience, and a man without experience is a pretty poor man to hire. The result of this method of teaching is that the boy finds that he must think for himself or get dropped; so he thinks. He also finds, as we all do sooner or later, that it pays well to stop and think it out. The most valuable thing that any man can acquire in school or anywhere else is the faculty of thinking about a thing logically and independently. That faculty is not a thing which will stand transplanting; it must be raised from the seed. After the seed begins to germinate, every bit of discouragement seems to make it grow the faster. But if no seed is sown, it has no chance. If the seed is sown too late in life, it has only a little show.

Young Children Taught on the Same Principle

I do not know how young it will do to begin, but I have tried it on my own children at 6 and 7 years of age, with success. I have kept them at home, and Mrs. Entropy has been teaching them on an average about an hour a day. She has taught them on the plan above outlined, giving as little help as possible till they have something to show. For example, in reading she does not tell them what a word is till they have spelled it and tried to say it, or guess it if you like better. Now those children are not abnormally bright by any means; they are but little if any above the average of children here, but that one hour a day has done more for them than two years of six hours a day schooling has for their playmates. I have tried this thing with all sorts of boys from this age up, with remarkably satisfactory results. Not always do the students respond by acquiring a large amount of knowledge, for I have not the slightest doubt but that the boy under the "laboratory" system could make more of a show at examination time; but they seem to grow in general intelligence and ability to cope with new things. One set of boys I watched through three years of this treatment, in at least one important subject each year. Those boys can go out into the world, and they can adapt themselves to their surroundings and begin to make good in short order, while boys who have followed the "laboratory" system make more of a show in doing things that they are told to do, but less of a show in taking hold and doing without a specific order.

I remember that when I was a little fellow my father took me to drive a great deal. We drove out through the country roads everywhere in a radius of 20 miles, and he had me drive. I went where he told me, and I learned how to turn out of street-car tracks, and to keep my reins up and how to humor a horse—but—when I bought a wheel and started to take the future Mrs. Entropy with me to ride, how we got lost! Everywhere we went looked familiar to me, but I couldn't place anything. I had done what I was told; I could drive anywhere, but I could not get to the particular place I wanted to except by chance.

The Ability to Plan

That is just the way with the "laboratory" boys; they can do finely just what they are told to do, but they cannot tell what should be done first nor what last, nor have they the slightest idea how to plan for the work on an entire machine. Now of what use can it be to a technical graduate to know how to turn a piece of steel to a certain size if he doesn't know in what order the different parts should be fitted? That is his job, to plan work for others to execute. He cannot do it intelligently unless he can execute to some extent himself, but his main job is to think it all out before anything is made, and the training in this faculty is something that I do not see how the "laboratory" system can accomplish.

An Attempt at Designing in Which Many Things Were Overlooked

One illustration of the method that I advocate will be enough to show the idea. A boy was set to make the drawings of an arbor press. He worked over it for quite a while and submitted a general sketch showing his scheme. It was approved and he was set to work it up. On one shaft he had five bearings, gears, etc., that is, five different fits to be made. His drawing at first called for a straight shaft 2 inches in diameter. First, he was asked to say how much finish would be necessary. His answer being rather doubtfull, he was told to find out. It took him half

an hour to find some one that could tell him. Then he was asked if he could easily get 2 1/16-inch round steel. Another trip to the shop convinced him that he might as well make the shaft either 2 1/16 or 1 15/16 inches, finished size. Then he was asked how he was going to slide a solid bearing 1 15/16 inches in diameter over a drive fit of the same nominal size of shaft to get it where it belonged, and so on, one step at a time. This fellow's eyes were opened to the fact that there was something to think about.

LEARNING TO THINK

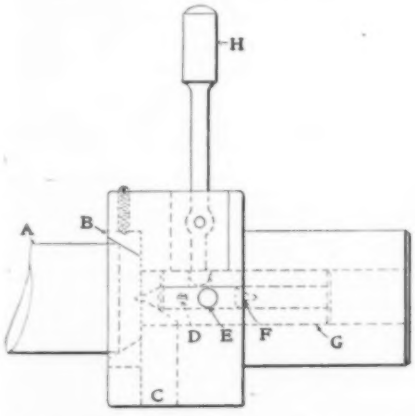
Now all these things could have been told him in a lecture in 60 seconds and they might have stayed with him 60 minutes; but now they will stick just as long as he sticks to this earth.

That illustrates, I think, as well as anything could, that it is not the mere getting over the ground that we should ask for. It is the way the ground is covered. A college educated boy stands today a better show than the technical man, after both have been out of school five or ten years. Why? Because while the college educated man has learned nothing that he can turn into dollars and cents at graduation, he has learned to think and to digest what he sees and hears, to size up his neighbor and his competitor, to see through things logically and to see his opportunity and grasp it, while our technical boys have been taught to do a little something useful, and are so blinded by that little something that they do not see their chances when they come before them.

ENTROPY.

A Centering Tool for Large Turret Lathes

We have a great many shafts to make on the 2-inch turret lathe, sizes and



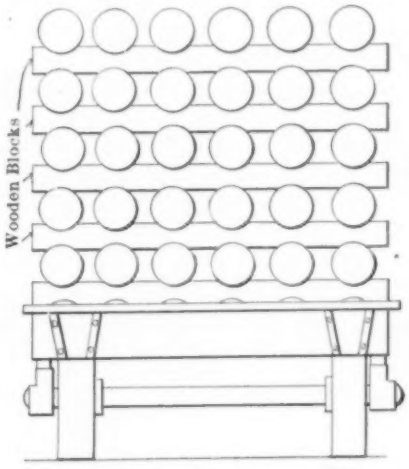
A CENTERING TOOL FOR LARGE TURRET LATHES

lengths up to 20x30 inches, centered on both ends ready for the grinder. We broke quite a lot of center drills when using the turret to feed the drill. The tool in the sketch proved very satisfactory, as we could bring the turret up to let the end of the shaft rest lightly in the taper bushing and feed the drill in with lever *H*. I had several bushings made for other size shafts. They were hardened and ground. *G* is a bushing to hold the Slocomb center drill, also for lever *H* to operate. *D* is the set-screw to hold the drill. *E* is the hole to get the screw-driver in to tighten or loosen the screw *D*. *C* is the hole for the chips to fall through. *A* is the end of the shaft in position to be drilled. The taper bushings cause the shafts to run true.

J. MCKAY.

The Handling of Heavy Bar Stock

Short, heavy bars are awkward things to handle, and it is these awkward things



TRUCK FOR HANDLING HEAVY BARS

that are too often dangerous to a fellow's toes and fingers in a machine shop. Such bars are generally seen piled up in the form of a pyramid, and in that shape they are difficult to get at. The great weight makes it an easy matter to loosen the bottom bars, and then only a slight jar is required to bring down the whole pile on a man's feet before he can escape the crash.

At a shop in Cincinnati I saw a neat method of handling such stock. This firm uses a great quantity of short, heavy steel bars for the overhanging arm of milling machines, of which it makes a specialty. These bars can be seen piled around the different departments of the shop mainly on trucks, as shown in the accompanying cut, which gives an end view of a truck load.

Pieces of timber running across the truck are grooved to fit the bars and holding the bars apart, so that you can get your hands under them or pass a leather loop around them to lift with a hoist. This idea is a simple thing, but it may be well to mention that a number of little things in a shop may be the cause of its being much ahead of another not so progressive.

CAMERON.

Winding Springs by Hand

The following is a simple way of winding springs by hand, which may be new to many of your readers. I have wound springs of ⅛-inch steel wire on a 1-inch mandrel by this method, and they were as perfect as if done in a lathe.

The mandrel should have a hole drilled near one end and the end of the wire inserted. Take two pieces of heavy leather, as from an old belt, about 2 inches square, the size depending on the dimensions of the spring to be made. Place the mandrel and wire between the pieces of leather and clamp in a vise, tightening the jaws until the mandrel turns stiffly. All one has to do is to start the wire with the desired pitch; afterward it follows the grooves made in the leather, which form a guide for the wire as it winds onto the mandrel. When fairly started, give it a little oil. The spring, when wound, will fit the mandrel closely.

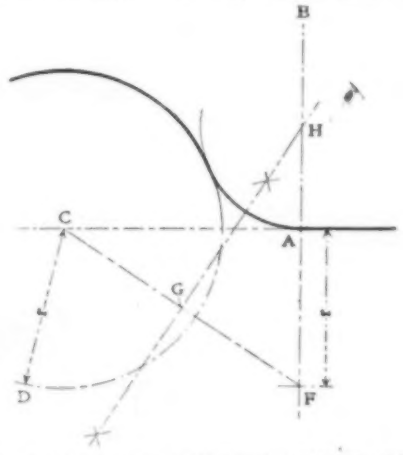
This method is very handy when one wants a few springs in a hurry.

EDWARD M. JOHNSON.

Drawing an Arc Tangent to Another Arc and to Its Diameter at a Given Point

The little problem shown in the accompanying sketch is sometimes met with in laying-out, and I presume many have solved it for themselves just as I did several years ago. It might be a convenience for others to have the solution ready-made, and I am, therefore, sending it with this object.

Given a circle *C D E* with center at *C*, and a diameter produced *C A;* through some point *A* on this diameter, outside of the circle, passes a line *A B* perpendicular to the diameter. It is desired to describe



DRAWING AN ARC TANGENT TO ANOTHER ARC AND TO ITS DIAMETER AT A GIVEN POINT

an arc tangent to the circle *C D E* and also tangent to the diameter at the point *A*, the center of this arc being obviously somewhere on the line *A B*.

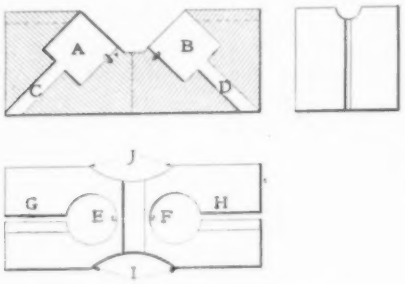
To locate the center, produce *B A* and

make $A F$ equal to the radius $D C$. Draw $C F$—or imagine it drawn—bisect it and erect a perpendicular $G H$ at its center, intersecting $A B$ in H; then H is the center required and $H A$ the radius.

BRACHISTOCHRONE.

Jig for Milling Ball Joint Cups

The jig is of mild steel. A and B are flat-bottomed holes of 1 inch diameter to receive the cups. C and D are ¼-inch holes for plunger to remove cups, after



JIG FOR MILLING BALL JOINT CUPS

machining. E and F are keys screwed into jig to fit keyways in cups, so as to insure recess being cut opposite keyways.

The jig is sawed through at G and H, so that it will close and hold cups firmly when it is held in the milling-machine vise. The jig is cleared away at the center I and J, to give the machine vise a better grip on cups. The slot $G H$ must not be cut clear through the jig, as is done in most milling jigs, owing to the insertion at keys E and F.

England. B. GEAR.

Rigidity in Machine Parts

In a recent conversation with an engineer of unusually wide experience, he brought up the subject of rigidity in machine parts and pointed out that our usual

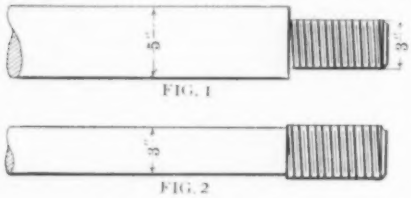


FIG. 1

FIG. 2

RIGIDITY OF BOLTS

factors of safety are inadequate for use in determining the size of many of these pieces. As an example he referred to a bolt which he recently designed (see Fig. 1). The strength of the bolt, as the term strength is used, required a diameter of only 3 inches. The element of rigidity, however, required a diameter of 5 inches. Thus Fig. 1 shows a body diameter of 5 inches and ends reduced to 3 inches.

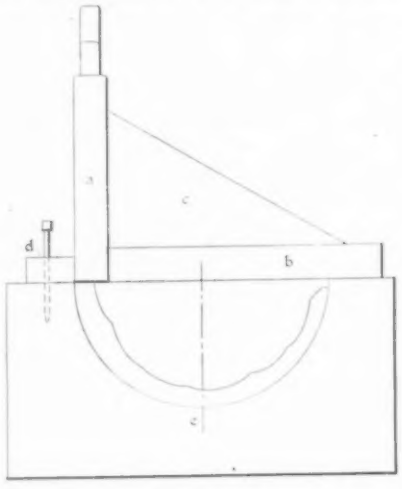
Undoubtedly this design has less tensile strength than the design of Fig. 2, which might be a good design figured on tensile strength alone. Yet, of course the resistance to deflection is much greater in the design of Fig. 1.

Cannot some AMERICAN MACHINIST contributor furnish some valuable and practical notes on the broad question of rigidity? L. P. A.

A Cheap Corebox Plane

For the benefit of those who have an occasional job of pattern work to do, without having any training in a pattern shop I show the use of the corebox plane, and a cheap and easy method of making one, as they are quite expensive to buy.

The cut shows an end view of the plane and method of using it; a is a ½-inch rabbit plane which can be bought for about 50 cents. On the side and flush with the bottom edge, a strip of hard wood b is fastened by means of screws and two braces c. The sides a and b



A CHEAP COREBOX PLANE

must be perfectly square, otherwise it will not develop a true semicircle. Care must also be taken that the knife does not project on the side.

After the pattern has been roughed out with a gouge, as shown, a strip d is tacked along the edge of the semi-circle to start the plane. It is best to cut down about ⅛ inch on each side, after which you can plane down to the line e, then by reversing the work the other quarter can be planed. CINCINNATUS.

Repairing Drill-press Spindles and Drill Sockets

When the edges of the slot in the drill sockets have become worn so that they do not present a square face to the tang of the drill shank then the trouble commences with tangs twisted off and broken drills. We find by using some method of keeping the socket shoulder square that the life of the socket (and also the drills) is greatly prolonged. The sketches show three methods of accomplishing this. In Fig. 1 the socket has a square hole slotted through it with exception of the bottom at A, which should be a slight dovetail, as this makes it easier to get a snug fit; the piece should be made a good press fit. It should be hardened, as this will give better wearing qualities. Fig. 2 is a similar repair. The sketch shows the method of employing two pieces. In Fig. 3, the socket is drilled straight through and tapped with a fine thread tap. The screws, Fig. 4, are fitted a good tight fit to the hole and are screwed up to place and marked, then removed and the bottom part

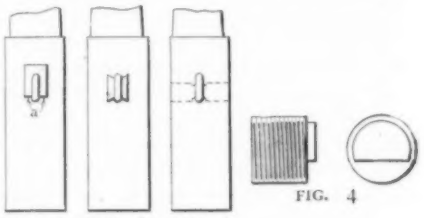


FIG. 1 FIG. 2 FIG. 3 FIG. 4

REPAIRING DRILL SPINDLES

of the end of the screw cut off, as shown, so that it will present a square shoulder to the drill tang. The best method of screwing the screw in is to leave a piece of stock on the end of the screw and cut a neck in it. After the screw is hardened it can be screwed in and the stock broken off and screw finished off by grinding.

W. T. HARRIS.

Shaving Tool for the Screw Machine

Where it is desired to manufacture pieces such as are shown in Fig. 1, where the length is considerable in proportion to the diameter, it is not always advisable to

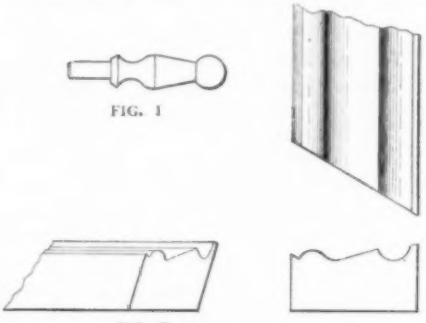


FIG. 1

FIG. 2

SHAVING TOOL

use a regular forming tool, and a shaving tool like that shown in Fig. 2 may be employed. This tool is used on the back slide. As will be seen, the cutting edge is of the same form as the piece to be made. When used on the back slide the tool passes under the work, and as the face of the tool is at an angle, it is forming a very small portion of the piece at a time. The tool may also be used on the front slide of the machine, but must then pass over the work instead of under.

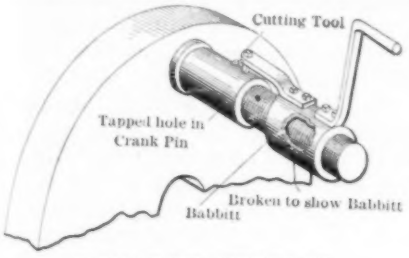
The tool should be set at a slight angle so that it will not rub after cutting. This

tool is ordinarily used in a special tool post, but may be designed to be used in the regular tool post.

FRED R. CARSTENSEN.

Turning a Roughened Crank-pin

Some time ago the company I am with installed a 400-horse-power engine. It had run about four months when one of those accidents occurred that the engineer



A CRANK-PIN TURNING RIG

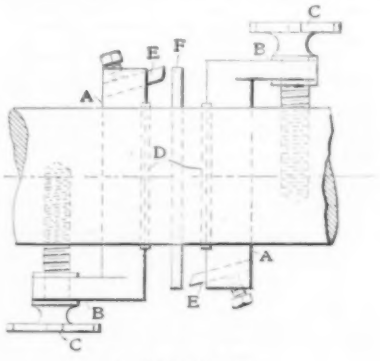
could not explain. The babbitt on the low-pressure crank box melted out and cut the pin in bad shape. The company called in engine manufacturers, and they all said: "It is a disk crank; we have no way of turning it. It will have to be pulled out and a new pin made and pressed in." I looked it over and told the superintendent he could have the engine running in twenty-four hours. The mechanical engineer laughed at him, but the superintendent said, "Go ahead." Inside of twenty-four hours I had my rig all made and the crank pin turned. It showed 0.003 out of round. I rebabbitted the box, re-bored it and had it running. It has not been touched since; not even scraped.

The accompanying illustration shows the turning rig and needs no explanation.

H. W. TYLER.

A Limited Facing Bar

I have taken great interest in the number of different articles in your paper on



A FACING BAR

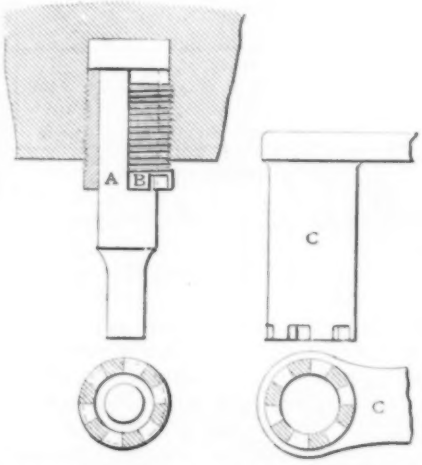
the boring bar, and just now, while the subject of boring and grinding gas-engine cylinders is attracting so much attention, would say the secret of a smooth bore is in the style and grinding of the cutters. Our cylinders having to be faced on both sides of crank case, we found it difficult to get a true cut, owing to feet extension which caused the long tool in the mill facing head to chatter and dig in. We also tried a flat cutter in the boring bar, but the cutting edge would not stay true, so I devised the following:

In the sketch is shown section of a 3-inch by 5-foot boring-mill bar with two 1-inch holes through as required. Into these holes tool holders are placed as at *A*, with the arm *B* to be worked by the star-feed screw *C*. A ¼-inch feather *D* takes the thrust of the cutters *E*. Through the center is a ½-inch ground tool-steel rod *F* for setting the cutters *E*, which have adjusting screws at the heel (not shown). In this case the cutters *E* are set 29/32 inch from the rod *F*, they travel 1¼ inches, the cuts are true and we face both sides at one time.

L. H. HAIGHT.

Securing Punches in the Plate

In making multiple-punch tools, it is often necessary to locate the punches as close as possible to prevent handling the



SECURING PUNCHES IN THE MULTIPLE PRESS

work more than once. The design shown is one I have found to be most efficient on heavy work.

The punch *A* is held in place by the threaded sleeve *B*, which is tightened up with the special wrench *C*.

This arrangement also permits of any punch being removed or replaced without disturbing the others.

G. RILEY.

Designs for Pivot Pins

It has come to my notice on various occasions that the general tendency among draftsmen is to use a shoulder screw for a pivot, in pivoting links and pointers, etc. There are some cases where a shoulder screw is necessary and a few where it is preferable; but generally speaking, I have found that the construction shown in the accompanying drawing is a stronger and better one.

The reason why I consider Fig. 2 a better construction than Fig. 1 is that point *A* in Fig. 1 is the weakest point and at the same time the point where the greatest strain will come. This sometimes causes the pivots to break off, in which case the screw stub has to be drilled out. With Fig. 2 construction the hole for the pin *B* may be drilled clear through the fixture, thus giving an easy means of driving it out in case of necessity. As the strain on a pivot is almost entirely side-

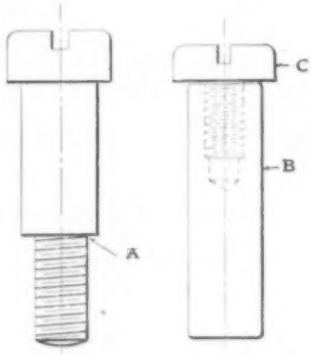


FIG. 1 FIG. 2

DESIGNS OF PIVOT SCREWS

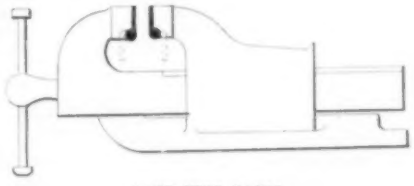
wise and very little up and down, a small screw is all that is necessary at *C*.

R. M. BURR.

Safe Vise Jaws

I noticed at page 856 an article on vise clamps, very similar to those I patented, last month.

There is a hinged piece of brass or other soft material held in position by means of two small screws capable of taking up wear so as not to allow clamp falling out of position when in use, yet it readily swings under jaw giving the vise its full capacity, such as holding large shafts or other work. The clamps project but slightly beyond the jaw ends, making



SAFE VISE JAWS

them in little danger of damage by rough usage of vise.

G. FEATHER.

England.

A Quick Auto Repair

In motor repair work it is nothing unusual to get a taper spindle or pinion wheel which requires re-turning or boring. The fellow's car is waiting and he doesn't trouble about anything except getting on the road again. In a case of this

kind where a new spindle was required and the pinion wanted re-boring, I set the pinion up and skimmed it out with the tool upside down; then turning the spindle, I put the taper on without moving the rest, and the result was a good fit in quick time.

It is necessary, of course, that the boring tool should be central. I have seen the idea used on one or two occasions, but its use is not very general. I do not suggest that fortunes will be made this way, but a garage which gets noted for quick as well as cheap repairs will not only make profits, but keep its clients and also gain more. In small repair work, whether motor or what not, it is the minutes which count.

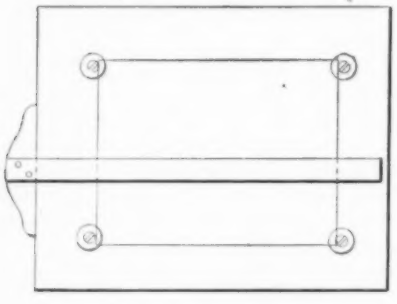
London. A. M. TURNER.

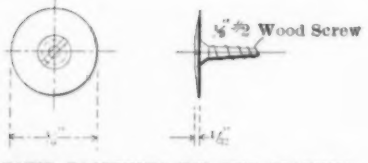
On Fastening Paper to the Drawing Board

The inclosed sketch illustrates a handy way of holding small sheets on the drawing board, when sheets of a standard size are used.

By slipping the corners of the sheet under the disks and tightening the screws, it is possible to hold it smooth and firm without punching holes in it or in the board.

The disks are made of thin metal and are countersunk for a small wood screw. They are also slightly chamfered on the





A PAPER FASTENING FOR THE DRAWING BOARD

under edge so that the paper or tracing cloth will slip under easily. The finishing touch is the rounding of the top of the disk so that when in use it will offer no more of an obstruction than an ordinary thumb tack.

A possible elaboration of this scheme would consist in substituting machine screws and metal tapped bushings in the board. L. C. WECK.

An Identification System for Machine Parts and Drawing

For any manufacturing concern making apparatus that does not require large and complicated drawings, and where the product is composed mostly of machines made up of small parts, such as automobile engines, stoves and agricultural machinery; the following system supplies a very adaptable means of making parts once detailed, available for use in connection with any assembly drawing, without the use of copious explanatory notes and cross reference. This system is in use in a hardware and stove factory in the Middle West. I will give only the bare outlines of the methods employed, leaving the evident points of saving in clerical labor and ease of record keeping to be seen by the reader.

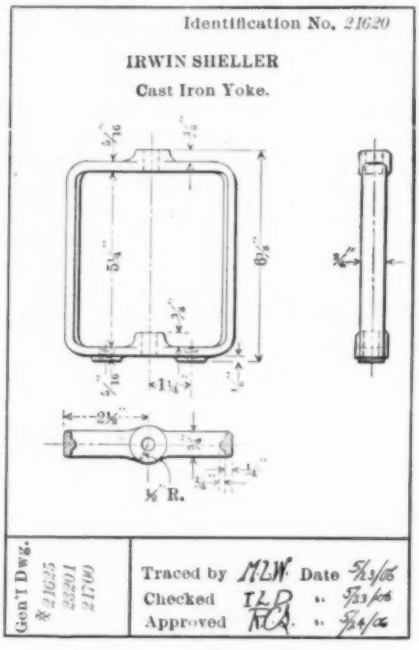


FIG. 1. A DETAIL SHEET

There are in this plant only two sizes of drawings. These are closely adhered to in all cases. These two sizes are: The assembly sheet, 30x20 inches, upon which is the lay-out of all general drawings; and the detail sheet, 14x10 inches. It is in the application of this detail sheet that this system varies markedly from prevailing drawing methods.

SCOPE OF THE DETAIL SHEET

A detail sheet never covers but one item. Under no considerations can more than one piece be detailed upon a sheet; and that one must be entirely complete in itself upon that sheet.

Fig. 1 shows such a sheet. It will first be noticed that instead of a *drawing number* on this sheet we have an *identification number*. The scope of this number is more than that of merely indexing the drawing. It serves to follow clear through the actual piece detailed. It acts as a pattern number, by which patterns and castings are known; if the piece detailed is not a casting, it is still known by this number, just as the piece or style number in other drawing systems serves to furnish identification for the actual part.

Thus there are no duplicate sets of numbers running for patterns, drawings, etc. Indices and cross references are reduced to a minimum. This is no mean saving where an attempt is made to keep records on types and parts of apparatus already detailed; as all up-to-date drawing rooms do.

The general drawing bears only such information as is necessary for the assembly of the apparatus and only dimensions and notes pertaining to this end. There is, however, on every assembly a detail list, which is a table showing all the item drawings required to make the completed apparatus. Fig. 2 shows such a list. The "Req'd" column gives the number of pieces of each piece that goes to make up one complete machine. For example, the eighth item in the list is a "Lifting Handle, Iden. No. 11,384 and Req'd 2." The last note means that two of these handles are required to make up every complete stove, and so on through the list. Thus it will be seen that this list is a material specification for the complete apparatus, covering parts and number of each going to make it up.

It must be emphasized that every detail drawing is complete in itself, and is a unit that can be used anywhere without interference with existing work or necessitating new records. For illustration, the handle referred to above also occurs on seven other general drawings. This handle is complete in itself, known by one number, 11,384, goes to make up eight different types and sizes of stoves, and one drawing is available for all cases after the piece has once been drawn.

Iden. No.	Name	Req'd
12621	Base	1
16294	Front plate	1
16295	Doors	2
15464	Sides	2
16297	Hinges W.I.	8
" 9642	" Pins	8
16296	Cover plates	4
11384	Lifting handle	2
9647	Feet	4
9250	Ash box	1
16298	Rack	1
7296	Grate	1

FIG. 2. A DETAIL LIST

No duplication of drawing is necessary. This is a big item, and one that is hard to overcome where several different parts are detailed upon one sheet.

As a matter of record the detail drawing has listed at the bottom the general drawings using it, so that in the case of changes in the detail piece the complete apparatus it affects will be known.

An Economical and Practical Cost System

On page 193, in the upper part of the tabulation Form VIII, the cost per pound of good casting produced is erroneously given as 0.0012. This should be 0.0112.

An Inspectors' Gage

On interchangeable work where the same operation is carried on continuously day after day and week after week, the cost of elaborate gages may be well repaid. The illustrations Figs. 1, 2 and 3 show a device gaging two diameters, the depths of two holes and a groove shown in section at *A*, Fig. 3. A master plate *B*, Fig. 2, for the outside shape of the part is fastened to the cast-iron base plate *C* with two machine screws and two dowel pins. The part is then gaged from the master plate to the exact shape on the outside all around, with the aid of a sharp-edged diemakers' square, so that the least possible error can be detected in each independent of any other, either in the holes, depth, or its shape.

The model has a sliding fit in the block *D*, which is made of machinery steel case-hardened, ground and lapped on both sides. Two screw holes and dowel-pin holes are made in the block before hardening, and 0.010 inch of stock is left on the bottom for grinding when assembling. On the right-hand side of this block is fastened a sliding-gage block *E* with two screw holes and two dowels, as shown in Fig. 3. A T-groove is milled in the middle. This is done in order to lap the sides and the bottom perfectly clean after hardening and to fit the sliding groove gage *F*, which has a round nurled handle fastened on with two dowel pins.

On top of the slide block *E* is fastened a 3/8-inch plate *G* with a slot 1/64 inch wider than the plate *H*, which is held with two pins in a groove in the sliding gage *F*. A multiplying arm *I* swings on a shoulder screw; it is made long enough to multiply 15 times and registers on a head pin *J*. A flat spring *K* is held in a shoulder pin with a dowel through its center to push the multiplying arm away from the work when gaging and against the sliding pointer when in operation. Two stop pins are driven in, one on each side of the multiplying arm, in order not to break the flat spring. Block *I* is left soft, and a straight hole in the center is a driving fit on the tool-steel bushing *M*.

This bushing has a recess in the middle of the hole, a distance of about 1/2 inch from each end. These are made in order to lap the hole straight after hardening, and, for another reason, so that the plug *N* will not be apt to stick in the hole when standing idle after having been lapped and finished. A round-nosed cut is taken on each end of the bushing to a concaved edge in the hole, to show the gaging by zero marks. Plug *N* is also recessed in the middle of the hole to within 1 inch from each end, and is ground and lapped all over to a turning fit in the bushing *M*. It is customary to fit gages of this kind so they will enter and turn without using any heavy oil; because if oil is used to a perfect fit and allowed to stand, it will become so heavy that it will gum the two members together to such extent that it is impossible to get them apart without using a hammer. This is apt to be injurious to the gage. Inside, the plug *N* fits the plug *O*, which has a head pin *P* driven in at the end. Its head sticks through the plug *N* and its top conforms to the circle diameter of the plug *N*.

Now, after all the three blocks are ground on the bottom until the right hight is obtained for the plugs to enter the holes and groove in the model without binding, the gage is complete and assembled. A little beeswax is flowed on each end of the bushing *M*. When cool, a line is drawn across one side of the bushing and onto the plugs and pin *P* as shown, with a zero mark and a line. These lines are then etched in with acid. With this double-plug system a correct diameter and depth can be obtained.

R. A. ALMOND.

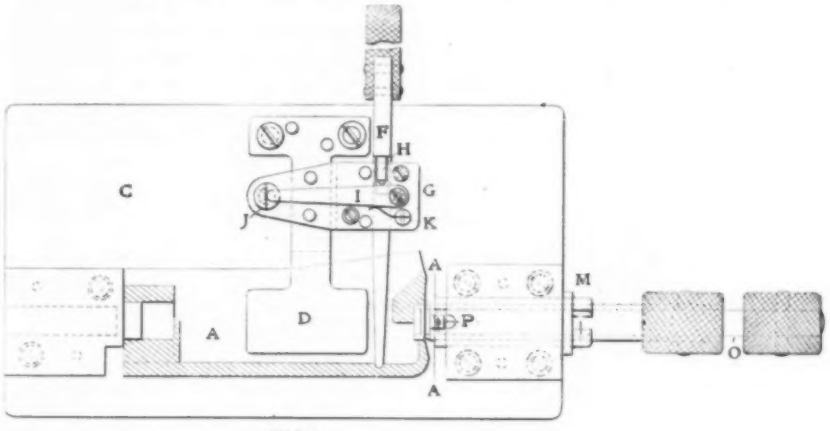


FIG. 1

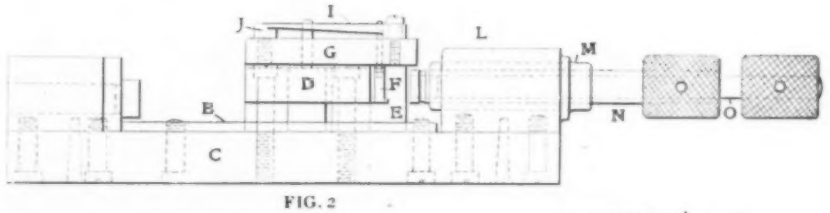


FIG. 2

AN INSPECTOR'S GAGE

Who Pays the Freight?

A man recently put the above question to me. A certain concern had contracted to do several thousand dollars' worth of work for a customer at so much per hour. The reputation of the concern doing the work is the highest, and the material was the best suited for the parts of the machine for which it was used. Certain parts were made of tool steel hardened, ground and lapped. These parts could not be tested until the whole machine was completed.

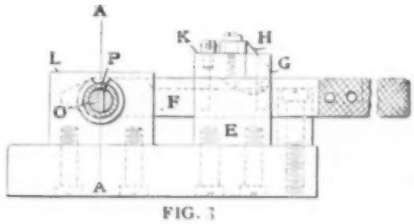


FIG. 3

When the machine was finished, it was discovered that certain of the tool-steel parts were too hard and others too soft. The question raised was, Who pays for new parts, the customer or the shop, when the shop takes a job at so much per hour?

Suppose the drawings called for a hole 1 1/2 inches diameter and the machine hand bored it too large; the cost would naturally fall upon the shop. Again, supposing a piece of steel is to be shaped and tempered; if it cracks while being tempered or after being tempered, no one would think of holding the shop responsible.

It is a well known fact that two pieces of steel from the same bar will not, even

when apparently treated in exactly the same way, give the same results after being hardened. Why, then, should the shop be held responsible for variation from suitable hardness in any piece of tempered steel, providing of course that usual care has been taken to obtain the desired results?

It is reasonable to suppose in the case cited that the work was given to a man who knew how to temper, and that he used care in doing the work. It would be interesting to know the law of this, and also the equity, though they might differ considerably. E. A. DIXIE.

Utilizing the Exhaust Heat of the Gas Engine

Very few of the users of small gas engines realize the vast amount of heat that is carried away in the exhaust. The gases in the cylinder easily reach a temperature of 1500 degrees Fahrenheit, and fully one-third of their heat is wasted. Steel manufacturers are now utilizing blast-furnace gas, which formerly went to waste. Why is it not just as practical to use the hot exhaust gases from an engine cylinder?

The man who has a small pattern or machine shop, deriving his power from, say, a 20 horse-power gas engine, can economize materially on his winter's fuel bills for heating. Usually he keeps three or four large open stoves going all the time, fairly eating up the coal, and only heating the shop in spots. If he will use his exhaust, he can obtain an even temperature all over the room and, at the same time, not burn any solid fuel.

If the shop is not too large and spread over too much area, it can be piped for hot water, with the circulating pipes running into a coil. This coil is placed within a metal drum, or box, properly protected with asbestos or some other heat insulator. If the engine exhaust is carried into this box or heater, it will heat up the water in the coils, thus starting through the pipes a circulation which will be constant. After the gases have become cooled in the heater, they can escape to the atmosphere through a waste pipe.

In a small pattern or wood-working shop, where the size of the engine is too small to be used for heating purposes, it can be utilized for a number of things; for example, the heating of glue. To accomplish this result, lead the exhaust into a larger pipe or water-tight box surrounded by the glue-pot water. The hot gases will pass into this space, give up their heat to the water and finally escape to the atmosphere through the outlet.

There is another advantage in thus using the waste heat. When the engine exhausts into a large box or receptacle, placed as near as possible to the engine, it acts as a muffler and silences the explosion without producing any back pressure in the cylinder.

The examples enumerated are but two of several uses to which the heat of this waste gas can be put by adapting apparatus to each local condition. It can even generate steam if a suitable boiler is attached. By utilizing this heat, men who previously were barred from using the gas engine on account of the necessity of having steam for their work, can install gas engines in their plants, and at the same time have steam for drying, seasoning, or any other use, without maintaining a separate boiler.

A. K. READING.

Threading Taps and Gages

When cutting threads on taps or gages on some grades of steel, especially on very soft annealed tool steel, the lathe hand frequently meets with difficulty in obtaining a smooth thread, often on account of a deposit of soft steel left on the top of the threading tool and adhering to it like solder.

This deposit at times crowds over the top of the tool, causing the tool to gouge or tear the thread. It has been suggested in a letter from one of your readers that a piece of annealed copper made into the form of a scraper and used on the top of the thread tool at the end of each cut would keep the tool free from this deposit. Having tried this I can say it helps to a certain extent, although the deposit will form enough to cause the trouble before the end of the cut.

I find that a satisfactory way to obtain a smooth thread where there is trouble of this nature is to turn the tap within 1/16 inch of finished size, then heat as in forging, and hammer well all around that part of the tap that is to be threaded. Allow it to cool off in the open air. This makes the steel in the tap firm, which will prevent it from adhering to the threading tool.

D. CLIFFORD.

A Punching Die

Fig. 1 shows a die and punch which were made by a firm of engineers by whom the writer was at one time employed, to produce the blank at *A* from a 2x½-inch steel bar. Any toolmaker will see that this die and punch are entirely unfitted for the work to be done; in fact it could not work. Nevertheless it was made and tried, then relegated to the

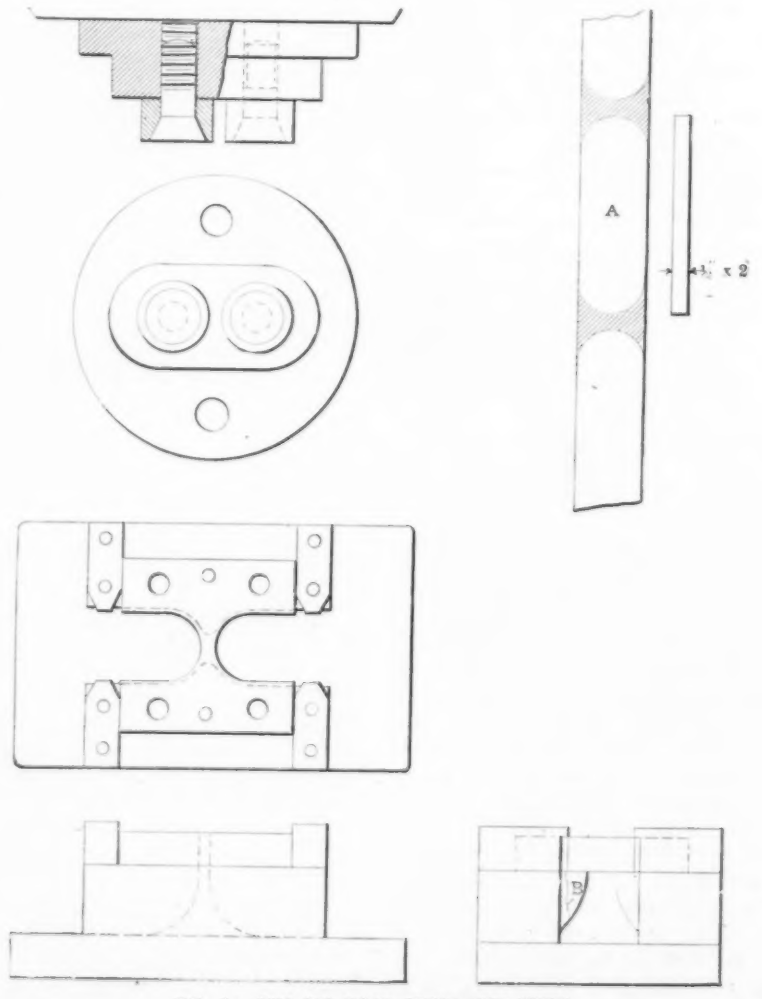


FIG. 1. THE DIE THAT COULD NOT WORK

scrap heap. The shoe broke through *B* on the first trial; but, although this might have been remedied, the whole principle of the die and punch was wrong, the only good feature about them being the ease of construction. At a glance a toolmaker may see that the die plate would be very easily broken, and the scrap would lodge in between the punches and stay there.

Fig. 2 shows how the die and punch were made by a manufacturing concern which later on undertook the same job. This die and punch were used in a Long & Allstatter press and produced the blanks *A* on the gallop, by feeding the stock up against the stop *X*. The die and punch were used for many different lengths, but had the bad feature of wasting too much in scrap, which in a short link was considerable, as there were about 50,000 links of 6-inch length to be gotten out. They were to form part of an air brake for railroad cars. The punch and die, Fig. 3, were put on the job and made no avoidable loss in scrap.

These dies are exceedingly simple and will explain themselves, but they illustrate the wrong and the right way of doing things.

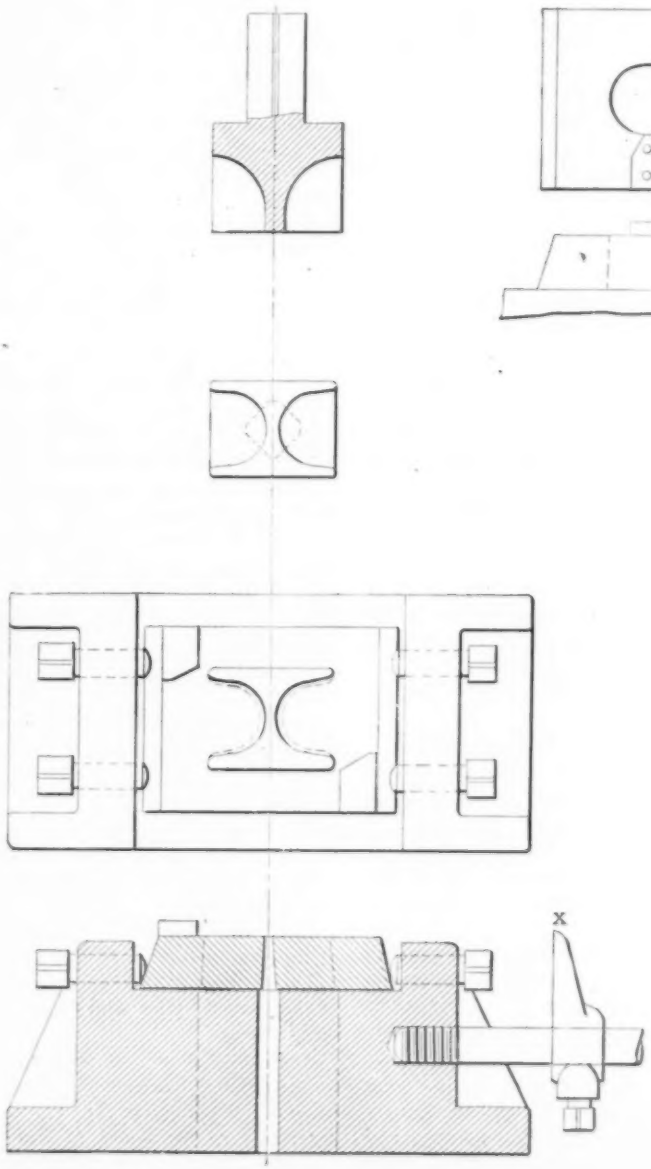


FIG. 2. THE DIE THAT MADE THE BLANK *A*

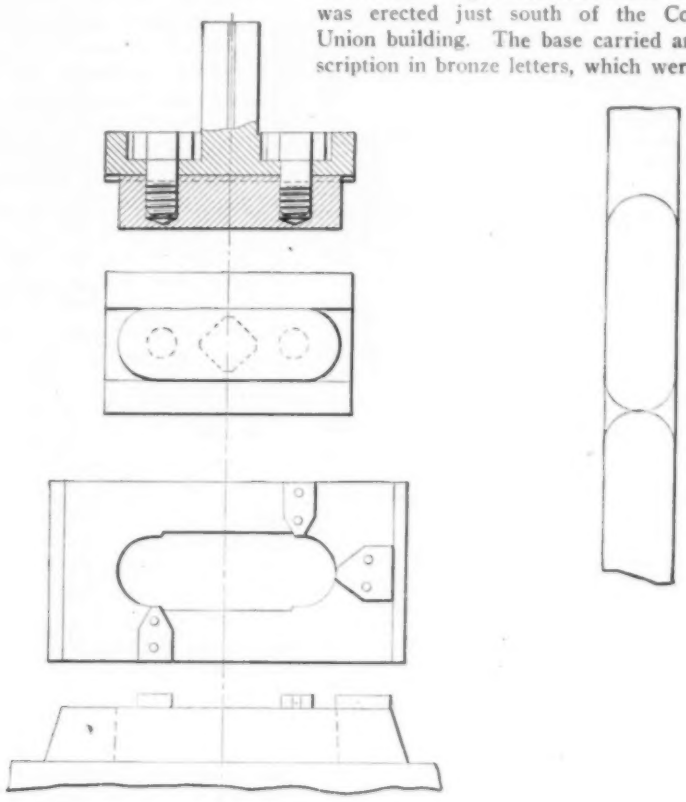


FIG. 3. THE DIE THAT MADE NO SCRAP

Metal Thieves

Thieves understand perfectly the market value of bronze in any shape, and they know that brass, copper and bronze scrap can be readily sold in all the large cities. Several years ago a statue of Peter Cooper was erected just south of the Cooper Union building. The base carried an inscription in bronze letters, which were attached as securely as possible to the stone. This statue is in a small park open to the public at all hours. It has been found impossible to keep the inscription perfect, as the letters were pried off almost as soon as put on. Now the same breed of rascals have discovered that the coal chutes and hydrants of the new Hall of Records are of bronze, and they have been stolen. The Hall of Records is a public building, erected and owned by the city of New York; the thieves, therefore, probably thought they owned a portion of the structure as citizens of the town, and they would take their portion now. But the gratitude supposed to abide in the breast of criminals toward those who helped them was lacking in the case of the Peter Cooper statue. Their action toward the effigy of their benefactor was more to be despised than that of the rogues who substituted iron for bronze in the fittings of the Pennsylvania State Capitol building.

Some years ago the roof of the city hall in a certain city was stolen in broad daylight by a crowd of metal thieves. The roof was copper and the theft was performed in such a businesslike manner that the city fathers never suspected until the rain was dripping into the offices beneath.

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During 1906 *the* AMERICAN MACHINIST *printed and circulated* 1,083,205 *copies, an average of* 20,832 *per issue. Of this issue* 17,750 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

Contents

	PAGE
Graphic and Other Aids in Designing	285
Method of Piecing Out Work through Department Foremen	287
Forging of Alloy Steels	289
Tin, Titanium and Cobalt Steels	291
Design of Eccentric Pull and Push Rods	292
Locating a Crane Trouble	293
Design and Use of Ball Bearings	294
Annealing High-speed Steel	299
Multiple-Spindle Tailstock for Turret Work on an Engine Lathe	300
Machine Molding of a Chaff-cutter Mouthpiece	302
The Premium Plan	304
Practical Letters From Our Readers: A Cross-sliding and Recessing Tool....Laboratory vs. Shop in Technical Colleges—Centering Tool for Large Turret Lathe....Handling of Heavy Bar Stock....Winding Springs by Hand....Drawing an Arc....Jig for Milling Ball Joint Cups....Rigidity in Machine Parts....Cheap Core-box Plane....Repairing Drill-press Spindles....Shaving Tool for Screw Machine....Turning Roughened Crankpin....Limited Facing Bar....Designs for Pivot Pins....Safe Vise Jaws....Quick Auto Repair....Identification for Machine Parts and Drawing	305-310
Uniform Bill of Lading	314
Civil Service Examination for Mechanical Draftsman	314
Passing of Free Engineering Advice	314
New Tools and Machine Shop Appliances	316
Is Electrical Welding Safe?	318

A Uniform Bill of Lading

Ever since 1904, and upon the initiative of the Illinois Manufacturers Association, the matter of a uniform bill of lading has been before the Interstate Commerce Commission, and the various manufacturers' associations throughout the country. By reason of hearings that have been held before the commission it became the opinion of that body that the various conflicting interests of carriers and shippers should get together and report a suitable bill of lading to the commission. That was done, and the result was that on June 15, last, a form of bill was presented to the commission for its consideration. As the outcome of that movement a meeting of the commission will be held October 15, 1907, at which the carriers are requested to be present, and show cause why this proposed form should not be approved as a just and reasonable regulation to be observed after January 1, 1908.

Among other things this bill makes impossible the shifting of the responsibility from one carrier to another not a signer of the contract in cases where a shipment passes through the hands of several carriers by providing that "each carrier of all or any of said property over all or any portion of the said route to destination shall be subject to all the conditions, whether printed or written, herein contained." Among the exemptions of the carrier from damages is one covering the case where the property is stopped and held in transit upon request of the shipper, owner or other party entitled to make such request, in which case liability is limited to loss arising from negligence of the carrier—the burden to prove freedom from such negligence being on the carrier—and another case of the same kind is that in which property is shipped in open cars, under which again liability for damage can only arise from negligence, with the burden of proof the same as that stated above; damage in this case being, however, extended to cover the case of fire, in which event the liability is the same as though the property were carried in closed cars.

In case property is transported over a portion of the route by water, the carrier is not liable for damage, resulting from the perils or accidents of navigation, or from delays incurred when assisting vessels in distress, or engaged in saving life or property. This exemption is, however, waived in case the shipment is diverted from the usual route, and in consequence of such diversion is carried by water, in which case the liability of the carrier is the same as if the entire carriage were by rail.

It is moreover provided that the term "water carriage" shall not include lighterage across rivers, lakes or harbors and also that when property is carried under a rate which includes marine insurance, the liability of the water carrier shall cover all risks insured against and shall at least equal the liability for rail carriage in closed cars.

In case property is not removed within 48 hours after arrival at its destination, the carrier's responsibility is limited to that of a warehouseman only, and he may at his own option remove and store the goods in a public or licensed warehouse at the cost of the owner and there hold it at his risk and subject to a lien for all freight and other lawful charges, including a reasonable charge for storage. In cases when goods are received from or delivered to private sidings, they are to be at the owner's risk until the cars are attached to, and after they are detached from trains.

Civil Service Examination for Mechanical Draftsman

The United States Civil Service Commission announces an examination on September 18-19-20, at the places mentioned in the list below, to secure eligibles from which to make certification to fill two vacancies in the position of skilled draftsman (mechanical), at $1000 to 1200 per annum, in the office of the Chief of Ordnance, War Department, and similar vacancies in the position of mechanical draftsman at the salaries indicated, according to their rating as a result of the examination, as they may occur, for duty at any of the establishments named in the following list:

Augusta Arsenal, Augusta, Ga.; Benicia Arsenal, Benicia, Cal.; Frankford Arsenal, Phila., Penn.; Manila Ordnance Depot, Manila, P. I.; New York Arsenal, Governors Island, New York Harbor, N. Y.; Ordnance Office, Washington, D. C.; Rock Island Arsenal, Rock Island, Ill.; San Antonio Arsenal, San Antonio, Tex.; Sandy Hook Proving Ground, Fort Hancock, N. J.; Springfield Armory, Springfield, Mass.; United States Powder Depot, Dover, N. J.; Watertown Arsenal, Watertown, Mass.; Watervliet Arsenal, Watervliet, N. Y.

As the commission has experienced considerable difficulty in securing eligibles for this position, qualified persons are urged to enter this examination.

The examination will relate to the following subjects: Mathematics, materials, practical calculations, drawing, training and experience.

Age limit, 20 years or over on the date of the examination.

This examination is open to all citizens of the United States who comply with the requirements.

Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at any place mentioned in the above list, for application Form 1312. No application

will be accepted unless properly executed and filed with the commission at Washington prior to the hour of closing business on September 7, 1907. In applying for this examination the exact title as given at the head of this announcement should be used in the application.

The Passing of Free Engineering Advice

A bane of manufacturing enterprises as conducted in this country has always been the giving of engineering advice free; and in many cases, not only free, but with positive loss. Customers have expected bidders to do without charge engineering work which, in other countries, is paid for as a matter of course, and to do this before submitting bids, the cost being a dead loss in case the order is not secured, which, of course, means a dead loss for every bidder except one.

Cases have come to our knowledge, in which requests have been sent in for engineers to go long distances in order to inspect localities and prepare plans before bids could be made, and calls for services of this kind have been commonly yielded to by manufacturers, the cost of traveling expenses and the services of the engineer being put up at hazard on the chance of obtaining an order. Not infrequently plans prepared in this manner have been made the basis of competitive bids, the party making the plans being given no advantage whatever, other parties bidding on his plans and, in case of making lower prices, receiving the order.

To a large degree manufacturers are responsible for this attitude of the purchasing public. They have shown themselves "easy marks" willing to give away advice, and the purchasing public can scarcely be blamed for accepting what is offered. Cases have arisen in which manufacturers when bidding on plans submitted by the customer have suggested changes by which improvements or economy would be effected, with the result that all bids, their own included, were rejected, and new ones called for on the plans which were the result of their own gratuitous advice. Such things seem ludicrous and primitive enough, but a far worse case has just come to our notice, in which a prominent trading company received an inquiry by cable for the cost of a bridge for South America, and, at considerable expense to themselves and more to bridge companies, preliminary plans were prepared and estimates sent off. At a later date it was discovered that the information was wanted *to settle a bet*, without a shadow of intention to erect the bridge. To add to the ludicrous feature of the case the party who sent the cablegram subsequently came to this city and called at the office to which he had sent his inquiry, the presumption being, of course, that he had come to take up further negotiations for the bridge. Knowing the habit of people living in Spanish-American countries of attending to pleasure before business, the party was put up at a club and handsomely entertained at the expense of the trading company, and when, after a suitable lapse of time, the subject of the supposed bridge was delicately opened, he burst into a roar of laughter and explained that he had lost the bet. The conversation that followed is not suitable for print.

There is a rapidly growing tendency among manufacturers to put a stop to this giving of free advice. We have recently heard of two who, after much expensive experience, have now made it a rule to answer all inquiries of this kind by naming a *per diem* rate for the services of their engineers, which, together with traveling expenses, are to be rendered in a bill for services performed, with the proviso that the charge for the engineer's services will be remitted in case the contract is obtained, while the traveling expenses stand in any event.

This is plainly as it should be. There is no probability that the consulting engineer system as it prevails in England will ever find a large foothold in this country. Engineering work will, no doubt, continue to be done by the manufacturer as it has always been, and, indeed, there is no reason why the English plan should be taken up here. That plan has the large merit of placing the expense where it belongs, but that feature is just as well provided for by the plan outlined above, and from every other standpoint we regard the American plan as superior, as it is only by it that the full benefit of standardization can be obtained and an unnecessary multiplicity of designs avoided. There is indeed, we are informed, a marked tendency to abandon the typical English plan in England, especially in connection with electrical work, the change in this field being largely due to the influence and example of the British Westinghouse Company. The field of the consulting engineer in that country, as in this, appears to be rapidly narrowing to a general layout of plants, coupled with the selection of standard apparatus for the various parts. It can, however, we believe be only a question of time when the practice of charging for such work becomes nearly if not quite universal. Apart from such grotesque cases as the South American bridge, the existing plan has always been subject to many abuses, engineering advice being asked for before any determination to undertake the work has been formed, and services being expected of which the value is often out of all proportion to the extent of the intended improvement in any event. The plan of the two companies described cuts out abuses of this kind at the start, and in other cases it puts the burden of the expense where it belongs.

Scientific Safe Cracking

A curious story comes from Germany of the successful opening of a safe by a burglar by means of an oxygen-acetylene blow-pipe. The burglar cut a hole through the ceiling above the safe and lowered a complete blow-pipe apparatus, including an acetylene generator and two cylinders of compressed oxygen through the hole, and by its aid he melted away enough of the door to make the contents of the safe accessible—a tent of heavy blankets having been first built around the safe to prevent the operation being visible.

Protection from such a method of safe cracking by any possible improvement on existing lines of construction would seem to be impossible, and the emergency has called out the suggestion that protection can be obtained by means of apparatus which will liberate deadly fumes whenever the safe is tampered with. Among these is a suggestion for an apparatus which would liberate the fumes of prussic acid, and other suggestions less dangerous to innocent parties, but on the same general line, contemplate the liberation of fumes which would compel precipitate retreat without endangering life. Among such substances is obviously ammonia and another substance that would cause such profuse and persistent weeping as to cause temporary blindness if the attempt to remain in the vicinity were persisted in.

The Mitsu Bishi Engine Works, Nagasaki, Japan, has decided to construct a floating dock with a capacity for vessels of 12,000 tons displacement. The dock will cost $750,000 gold. About 5000 tons of iron material are required for its construction. Of the amount, 4000 tons have been ordered from the Edamitsu Iron Foundry, and the rest from an English iron foundry. It will be completed the year after next.

Personal

H. M. Kearns has been appointed special Government representative of the Pittsburgh Automatic Vise and Tool Company.

George Holden, formerly superintendent for Merritt & Co., Philadelphia, has assumed the position of superintendent for the Bernstein Manufacturing Company, Philadelphia.

Walter G. Stephan, formerly with the Wellman-Seaver-Morgan Company, has opened an office in the Citizens building, Cleveland, where he will conduct a mechanical engineering business.

F. B. Maltby, who has been connected with the Panama Canal work as principal assistant engineer to J. F. Stevens, has resigned to go with Dodge & Day, engineers and constructors, of Philadelphia, in the capacity of chief engineer.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A 20-Spindle High-speed Multiple Drill

This multiple drill is designed to drill 1¼-inch holes in steel on a maximum circle of 46 inches and a minimum circle of 18 inches with all 20 spindles, with a capacity in hight from spindle to bed of 66 inches and from spindle to box table of 51 inches.

The machine is designed for high-speed work; drilling at the rate of 55 feet per minute in 30- or 40-point carbon steel at a feed of 0.01 of an inch per revolution of spindle, with twenty 1¼-inch drills, requires about 45 horse-power.

Each drill has an oiling device which can be operated at will of the operator, as, for instance, if the work did not call for 20 holes to be drilled at one time, he could govern the oil to suit as many drills as he required. Oiling device is supplied by a Pratt & Whitney pump, which pumps 18 gallons of oil per minute into a distributing tank in the center of the head. This tank has twenty ⅛-inch pet cocks tapped into it and from these pet cocks is an Almond flexible tube which is fastened to the bearing spindle which supplies the oil direct to the drill and work.

Another feature of this multiple drill is the bed and special table. The bed, as shown in the illustration, has an opening in which there is a series of rolls which run on roller bearings so that the special table shown can be pushed into the center of the drill head and while work is being done under head, the operator can be getting his next work fastened to the table; immediately when the work is finished, the head rises and the table can be swung 180 degrees, the work drilled taken off and replaced with another piece to be drilled.

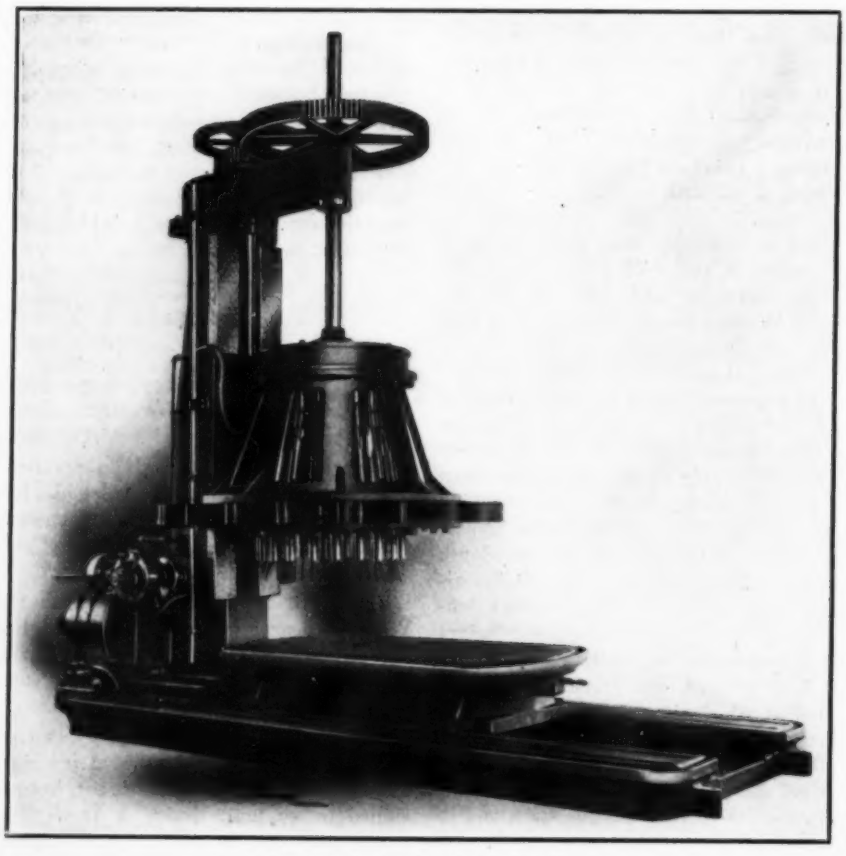
The multiple drill has a 3-step driving cone for an 8-inch double belt. Hyatt roller bearings are used. The cone shaft drives into a pair of bevel gears the driving pinion of which is made of rawhide and the gear of steel.

The spindles have No. 4 Morse taper and are tool steel. All shafts are ground to gages and the horse-power we recommend for this drill is 45.

Feeds are three in number, ranging from 0.007 to 0.018 per revolution of spindle. Six changes by gears can be obtained if desired.

The quick-return mechanism is obtained by a separate double-speed countershaft, independent of the countershaft of the machine proper.

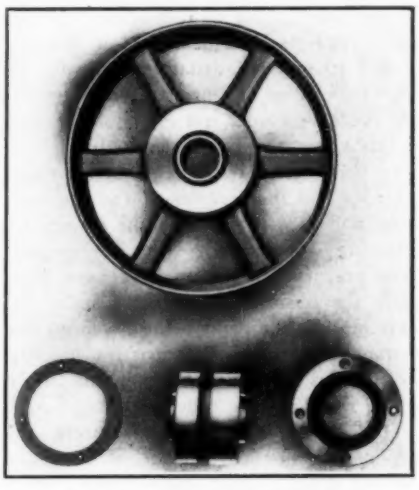
This machine is built by the Baush Machine Tool Company, Springfield, Massachusetts.



A 20-SPINDLE HIGH-SPEED MULTIPLE DRILL

Loose Pulley

A loose pulley is here shown which runs, not on the shaft directly, but on a supplementary cast-iron hub fixed to the shaft by two headless set-screws at right angles to one another. Thus a large bearing surface and a construction which retains abundant oil for lubrication are obtained, moreover the pulley may be applied to any worn places on the shaft without impairing its running qualities; and it is unnecessary to use a collar to keep the pulley in place, as it cannot get away from the hub, being held at one end by a flange formed on the outer hub, which is toward the observer in the picture; and at the other end by a ring which is shown separate in the lower corner. The groove running around the inner hub, which may be seen at the bottom of the picture, is connected with the ends by inclined oil holes so that when the pulley is in motion the oil is caused by centrifugal force to run out and lubricate the bearing surfaces; when at rest it runs back into the oil chambers, which are closed at the ends by the flange and ring. This pulley is made by Johnson & Bassett, Worcester, Mass.



LOOSE PULLEY

A Commutator Truing Device

The illustration shows a handy device for truing commutators, especially large direct-connected generators, in place. It is practically a slide rest mounted on a flat base with a socket which permits it to be set to correct hight. The device carries a ⅜x¾-inch tool, it has 15 inches of travel in line with the spindle on which the commutator is mounted and 5 inches cross feed. It weighs 75 pounds and is made by the Patterson Tool and Supply Company, Dayton, Ohio.

DEVICE FOR TRUING COMMUTATORS

A Variable-speed Clutch

The illustrations show a variable-speed clutch controlled by fluid pressure by means of which a desired speed of a rotating member may be obtained and maintained.

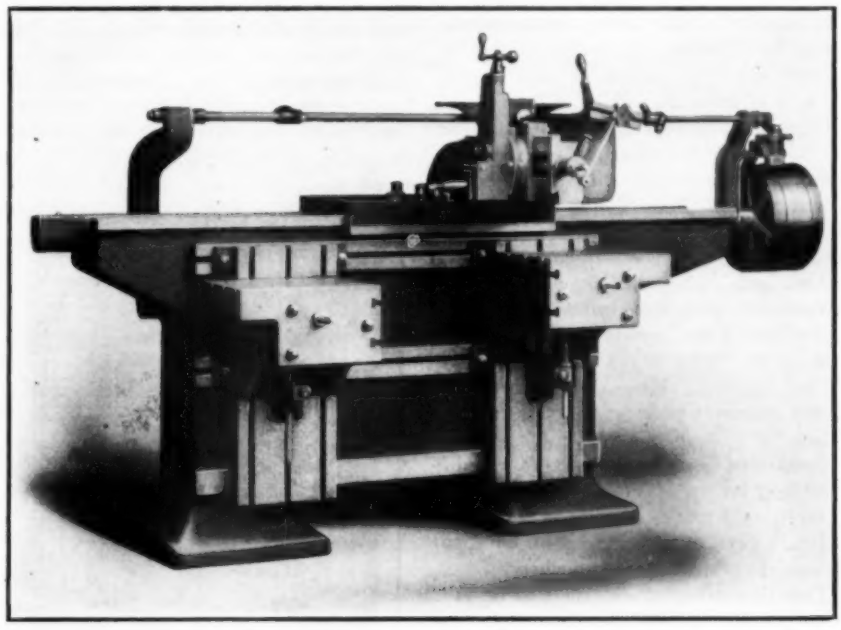
Referring to the illustrations, *A* is the clutch pulley which may be either a driver or driven. *B* are clutch shoes with counter weights. These are cast in one piece; the shoes at one end conform to the inside of the rim of *A*. The weights at the other end release the shoes from the inside of the pulley rim by centrifugal action when the fluid pressure is released. *C* is a telescopic cylinder which, when the pressure is applied, actuates the dogs *GG* connected with the shoes *B* and forces them against the inside of the rim of *A*. *D* is a stuffing box on the end of the shaft. *E* is a connection to a small air pump which is driven by the main shaft. In shops which have air pressure the pump is not required. The air flows from the pump through the pipe *E* and a drilled hole in the shaft to the cylinder *C*, forcing the dogs *G* which actuate the shoes, pivoted in the crosshead *F*, against the inside of the rim. The pressure of the shoes against the rim determines the speed at which they will deliver a certain amount of power; should the speed of the driver increase the shoes will slip.

This device is made by D. H. Champlin, Highland Park, Ill.

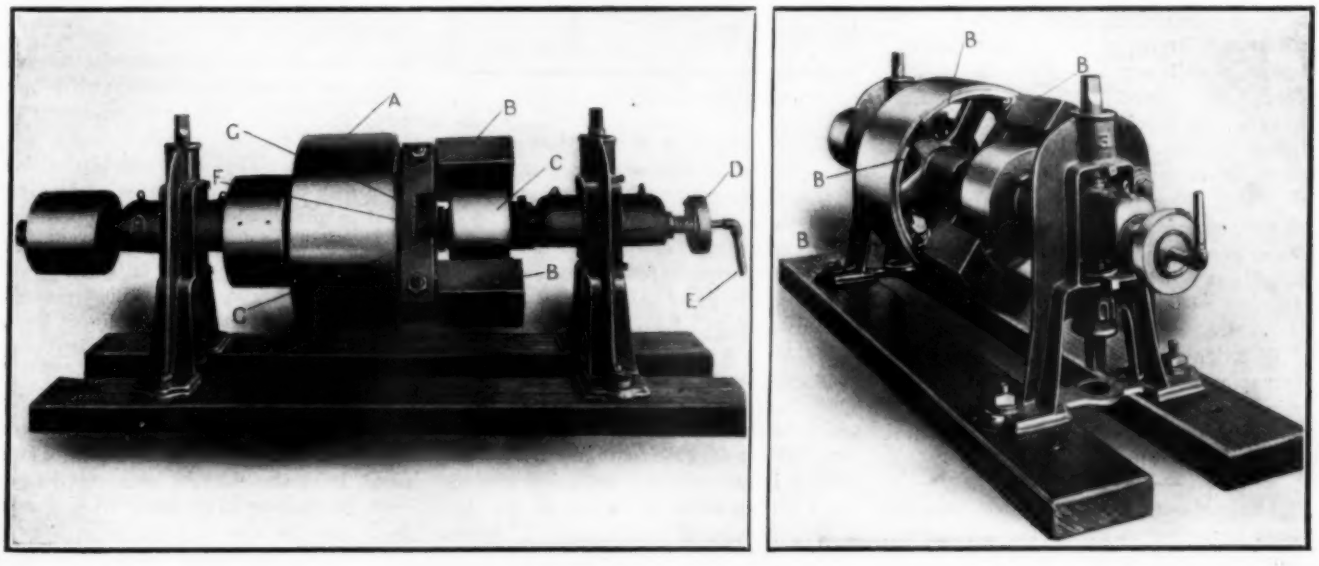
An Open-side Shaper

The illustration shows a 15x60-inch open-side shaper, which is the smallest of a line of open-side shapers. It is of the well known Richards type, with improvements, and for certain classes of work can be used to better advantage than either a pillar shaper, a traverse shaper or a planer.

The machine is driven by a single screw and bronze nut, without the intervention of any gears. The screw is 2⅛-inch diameter, made of 0.50 carbon steel. The saddle has a long and wide bearing on the column, with a narrow and deep guiding



AN OPEN-SIDE SHAPER



A VARIABLE-SPEED CLUTCH

surface to prevent binding, particularly when the tool is at the outer end of the rail, and is provided with a taper gib lengthwise adjustable by screws at each end, affording uniform contact on both sides of the gib.

The cross feed is by power or hand, positive, and adjustable. The down feed is by hand. The reversing mechanism depends on the turning of the shifting rod both for reversing the motion of the saddle and for the automatic cross feed to the head, the rod being automatically turned by cams on the saddle coming in contact with dogs adjustable on the rod, or by hand from the saddle, if desired.

There are ball bearings for the shifting rod, and under the elevating screw to the table. There are taper gibs to the cross-rail and to the head. The head has a down feed of 6½ inches, swivels, is graduated, and has a micrometer collar reading to 0.001 inch. The tables may be removed entirely and work bolted upon the aprons, or both tables and aprons may be removed entirely and work bolted against the face of the machine. Keyseating of shafting of any diameter may be done in the machine.

Length of stroke, 60 inches. Width planed, 15 inches. Maximum distance head to table, 23¼ inches. Width of table, 15¾ inches. Vertical adjustment of table, 19 inches. Depth of table, 15 inches.

This line of open-side shapers is built by the Cincinnati Shaper Company, Cincinnati, Ohio.

Cylindrical Clothes Lockers

The cylindrical locker shown is made of sheet steel on an angle-iron frame, tied together with iron rods, and supported by pressed-steel feet. The removal of three nuts permits the withdrawal of the tie-rods and the knocking down of the locker. A pressed-steel connector is supplied for batteries. Single tier lockers are provided with hat shelf, clothes hooks and master-keyed T-handle lock. It is claimed as an advantage for these lockers that the interior is well exposed when the double doors are opened. The "Cyl-Mee-Co" lockers are furnished by the Manufacturing Equipment and Engineering Company, in various sizes, single or double tier, with either plain or perforated metal doors, or perforated throughout, and with flat or conical tops. The office of the company is at 209 Washington street, Boston, Mass.

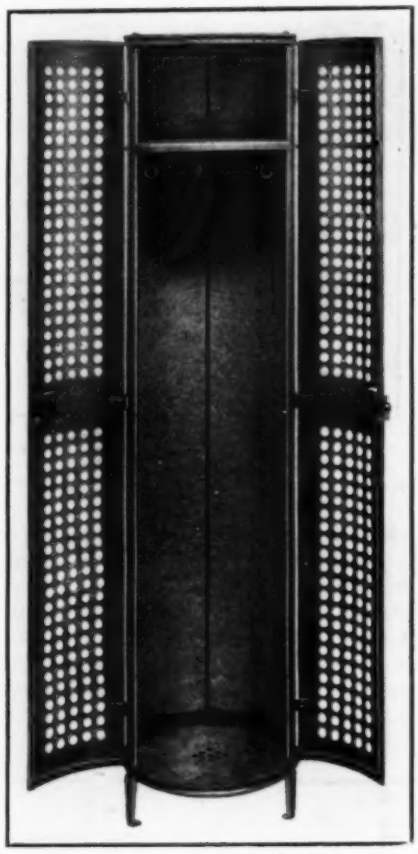
Electricity is being applied more and more to machinery used in British coal mines. Some mines are now so fully equipped that nothing workable by electric energy is otherwise operated.

The coal output of the United States in 1906, according to the Geological Survey, amounted to 414,039,581 short tons, having a value of $512,610,744.

Is Electrical Welding Safe?

By W. H. Booth

Is it or is it not a fact that electrical welding is a safe and sound operation? We hear much from the advocates of electrical welding, from the promoters of Thermit welding and from those who push the claims of the Fouché acetylene-oxygen blowpipe as to the merits of all these various processes. We are all aware that Thermit will produce a weld equal to the solid unwelded bar. Recently, by the banks of the Thames, I saw a large stern frame measuring about 11x7 inches welded by means of Thermit mixture. I am assured that the weld was perfect, was



CYLINDRICAL CLOTHES LOCKER

equally as strong as, if not stronger than, the solid bar, and from what I could see of the whole process I see no reason to doubt this.

By melting steel scrap into a faulty steel casting we are assured that such casting can be made good by the electrical arc-welding system. I see no reason to dispute this. The electrical arc has its praises sung as a means whereby a faulty spot in a steel casting may be made good and a heavy, costly casting saved without the slightest danger from the weld. However, it is not strictly a weld that is made but a casting within a casting, for the electrically generated heat is made to render molten the inner surface of a big blow-hole in order that it may unite perfectly with the scrap steel melted into the hole by the agency of the arc.

Patching a Battleship

Now all these methods of patching are good or they are bad. Recently there has been a great cry in the English papers because it has transpired that the stern post on the rudder casting of the great battleship "King Edward VII" was flawed and was surreptitiously repaired by the electric arc. The whole affair is regarded as a fraud. I fail to see it. The repair was done quietly and unknown to the naval authorities' inspectors. But this is no proof that the contractor who did the work felt that the work was bad. It may be simply a proof that he felt that the authorities were too much "hide-bound in red tape" to allow so novel a process to be employed. That a British battleship should be a thing of patches is no doubt very terrible; but we have little doubt that had Britain been at war and the same ship had come into port with a broken stern post, she would speedily have gone to sea again as sound as ever she was with this same stern post either electrically or Thermit welded, and the papers would have been full of its praises, just as now they are full of the iniquity of it or of the contractor.

Definite Results Should Be Known

One thing will probably come out of the present case. The modern systems of steel-casting welding, either by Thermit, electricity or acetylene, will be looked into, definite information will be forthcoming and they will be placed on a basis of proper recognition of their merits or demerits. There may be serious demerits; let them be shown up. I do not think there are serious faults, for I believe that all three systems have very great commercial value, and that they are eminently suited for the repair of steel castings which are often good throughout except for one bad flaw. Such a flaw can probably be made good; if so, why should any pedantic objection be raised against it?

In the case of the "King Edward VII," two if not three castings were ultimately made, and finally the Dockyard people made or got one made independently of the contractors, who, however, had to pay for the work. They are now blamed because they repaired No. 1 casting by electrical means. Is it not all very foolish? If electrical welding be so bad as this, let it be expressly stated and let there be no more of it. But if it is a sound process, then why let an academic sentiment block the way of modern improvements?

It is announced that a 7-foot vein of a fine quality of coal has been discovered near Valdivia, Chile, at a depth of 100 feet. It is the thickest vein yet discovered, the one at Lebu being from 4 to 6 feet, and the one at Lota from 4 to 5 feet. Steps are being taken to develop the mine.

A group of manufacturers in the iron trade at Erie, Penn., have established the Manitoba Iron Rolling Mills Company at Winnipeg, Canada. The mill and the puddling furnace are now in operation, using large quantities of scrap iron. It is the only iron mill in Canada between Port Arthur and the Pacific coast. Another new plant has gone into service at Port Arthur, which is using exclusively Manitoba ore. This mill is paid a bounty of $2.10 a ton by the Canadian government. Mills which use American ores receive a bounty of $1.10 a ton. At the present time the Dominion government is paying bounties at the rate of nearly $3,000,000 a year on the production of iron and steel.

The total capacity of the Canadian blast furnaces in the active list is 2335 tons a day; the capacity of the furnaces now planned or under construction is 1100 tons a day. There is no plant in Canada yet at which ship plates and the larger sizes of structural steel are made.

Business Items

Charles F. Elmes Engineering Works, Chicago, Ill., announce the completion of the new addition to their shops which will double the capacity of their tool and erecting floors.

The mechanical department of the Ralph Sellew Institute, Y. M. C. A., St. Louis, Mo., is starting a complete catalog file, and requests catalogs of all kinds of machinery, special tools and apparatus, engines, boilers pumps, etc.

J. E. Snyder & Son, Worcester, Mass., manufacturers of the Snyder upright drill presses, have moved into their new building at Parker and Dewey streets. This new shop triples the size of their old plant and will enable them to take care of their increased business and fill orders promptly.

Armstrong Bros. Tool Company, Chicago, Ill., are making further additions to their plant. Large volume of business makes two additional buildings necessary, and these are to be equipped with the latest improved machinery, which is now being set up and expected to be in operation about October 1.

The Smith Countershaft Company, of Boston, Mass., has had to enlarge their facilities to take care of the increased demand for their one-belt reversing countershafts. The Lyman Trumbull School, of Chicago, has just specified that these countershafts be furnished with all the machines for their new shops.

Trade Catalogs

The Risdon Tool Works, 63 Canal street, Waterbury, Conn. Folder descriptive of subpress. Illustrated.

H. H. Franklin Manufacturing Company, Syracuse, N. Y. Catalog describing die cast parts, illustrated, 4½x8 inches, paper.

Bullard Machine Tool Company, Bridgeport, Conn. Catalog describing vertical turret lathe, illustrated, 3x6 inches, paper.

Metal Hardening Solution Company, Rochester, N. Y. Catalog treating on the "Kalux" steel hardening solution. Paper, 7 7½.

H. B. Underwood & Company, Philadelphia, Penn. Catalog describing portable tools for railway repair shops. Illustrated, 6x9, paper.

Wm. H. Bristol, 45 Vesey street, New York. Catalog No. 17, describing electric pyrometers. Illustrated, 40 pages, 9x12 inches, paper.

Lea Equipment Company, 136 Liberty street, New York. Catalog No. 5, describing Lea-Simplex cold metal saw. Illustrated, 16 pages, 6x9 inches, paper.

Cleveland Twist Drill Company, Cleveland, O. A serviceable hanging price list of drills, reamers, sockets, etc., making a useful reference. Sent on application.

The L. S. Starrett Company, Athol, Mass. Catalog No. 18, describing fully fine mechanical tools, including useful tables and instructive concise information. Illustrated, 5x7½, paper.

The Watson-Stillman Company, 25 Dey street, New York. Catalog No. 70, descriptive of hydraulic forcing presses used for forcing fits or for driving broaching tools, etc. Illustrated, 130 pages, 6x9 inches, paper.

Sprague Electric Company, 527-531 West Thirty-fourth street, New York. Instruction Book No. 425, treating of the proper installation of Greenfield flexible steel conduit and flexible steel armored conductors. Illustrated, 44 pages, 3x5½ inches, paper.

Chicago Pneumatic Tool Company, Chicago, Ill., and 95 Liberty street, New York. Catalog No. 23 describing Franklin Air Compressors. Illustrated, 100 pages. Catalog No. 24, describing pneumatic tools and appliances, including hammers, drills, sand rammers and hoists. Illustrated, 100 pages.

The Cincinnati Milling Machine Company, Cincinnati, O. Complete treatise on milling machines. Concise information for milling machine operators, including speed tables for high-speed milling cutters, tables for cutting racks, and a chapter on indexing high numbers on the dividing head. Illustrated, 6x9, paper.

Goldschmidt Thermit Company, 90 West street, New York. Pamphlet describing butt-welding wrought iron and steel pipe and rods by the Thermit process. Illustrated, 12 pages, 6x9 inches, paper. Pamphlet containing an article by Hans Goldschmidt on "The Production of Pure Metals Free from Carbon by the Aluminothermic Method." 18 pages, 6x9 inches, paper.

Manufacturers

The Reading (Penn.) Iron Company will enlarge its plant.

The Albany (N. Y.) Steam Trap Company will erect a new shop.

The Chain Belt Company, Milwaukee, Wis., will build a three-story addition.

The Detroit (Mich.) Forging Company has commenced work on its new factory.

Franklin Handle Company, Beebe, Ark., will double the capacity of its plant.

The Wrought Iron Range Company, St. Louis, Mo., will build a new factory.

The Raymond Lead Company, Chicago, Ill., will erect a plant to cost $500,000.

The Overland Automobile Company, Indianapolis, Ind., will erect a new plant.

The McDonough Manufacturing Company, Eau Claire, Wis., will build a new foundry.

The Brooklyn (N. Y.) Rapid Transit Company will build new shops to cost $300,000.

The A. Gilbert & Sons Brass Foundry Company, St. Louis, Mo., will erect a new plant.

The Pelouze Scale and Manufacturing Company, Chicago, Ill., has bought site for a new factory.

The Sheldon Axle Company, Wilkes-Barre, Penn., will make improvements, expending nearly $50,000.

The Yule Spinning and Twine Company of Seattle, Wash., is erecting a new plant at Renton, Wash.

The Knight-Bunkeroff Piano Company, Charlotte, Mich., is enlarging its foundry for the casting of piano plates.

The Kingston (Ark.) Spoke Manufacturing Company has been incorporated with $15,000 capital. Joel N. Bunch is president.

The Newburgh (N. Y.) Ice Machine and Engine Company, is putting up a new erecting shop, and will also extend its foundry.

The Tomahawk, Wis., plant of the United States Leather Company was destroyed by fire. The loss is said to be about $1,000,000.

Contract has been let for the construction of a new machine shop for the Ensign-Bickford Company, Avon, Conn., fuse manufacturers.

Fire destroyed part of the plant of Wilcox Crittenden & Company, hardware manufacturers, Middletown, Conn., causing a loss of about $70,000.

The Bower Roller-Bearing Company, Dayton, Ohio, has been incorporated by C. H. Heller, R. F. Bower, E. D. Rike and others. Capital, $100,000.

The plant of the Cunningham Iron Company, Boston, Mass., manufacturers of boilers, was destroyed by fire, involving a loss of over $100,000.

The file manufacturing plant of F. Westfahl & Co., Milwaukee, Wis., was almost completely destroyed by fire causing a loss of $15,000. It will be rebuilt.

The St. Louis (Mo.) Gravity Lock Company has been incorporated. Capital, $10,000. Incorporators, Oscar Wiegmann, Clair L. Smith and Alphonso Knighton.

George McQuilken, Jr., chief engineer, power plants, Illinois Steel Company, 8o. Chicago, Ill., solicits the receipt of catalogs of steam appliances of all descriptions for power plants.

The American Chain and Foundry Company, Detroit, Mich., has been incorporated with a capital of $2,000,000. A plant will be erected for the manufacture of link belting, conveying machinery, etc. T. H. Simpson, of Detroit, is president.

The Memphis (Tenn.) Can Manufacturing Company has been organized with a capital of $100,000. W. A. McClure, connected with the Houston (Tex.) Can Manufacturing Company, will be president and general manager. The company will erect a plant for the manufacture of all kinds of tin cans.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper list free. E.G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

We desire a few more machines or specialties to manufacture. Box 423, Troy, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Second-hand Universal drafting machine; must be in good condition. Box 335, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Mechanical engineer can act as New York representative for small salary. G. E. Hackett, M. E., 71 Nassau St., New York.

Special machines designed and built; duplicate parts; model or experimental work. Mantle, Park ave. and 129th St., New York.

Wanted—A second-hand double disc grinder of the Gardner, Besly or other makes. Advance Pump and Compressor Co., Battle Creek, Mich.

We are prepared to figure on all kinds of machine work; new machinery designed or improved. Address Greenfield Steam Engine Works, Harrison, N. J.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Engine manufacturer with facilities, capital, etc., to handle new line of vertical high-speed steam engines will find it advantageous to address Box 336, AMER. MACH.

Men who operate grinding machines should read H. Darbyshire's "Precision Grinding," a $2 book that's worth ten times that money to you. Hill Pub. Co., 505 Pearl St., New York.

Young energetic gentleman, M. E., going to the west of the United States to Asia and Europe desires to sell the product of some first-class concerns. Address "E. B. P.," AMERICAN MACHINIST.

A well equipped machine shop and foundry desires to add to its output by the manufacture of articles of brass and iron, which would find a ready sale in the south; correspondence invited. Box 122, AMER. MACH.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Our new up-to-date foundry, just completed, equipped to make high-grade machinery castings; can take care of requirements of machinery builders and guarantee good work at attractive prices. Textile Machine Works, Reading, Pa.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in classroom and by correspondence. The New York School of Automobile Engineers, 146 West 56th Street.

Planer hands—C. Ashley, a planer hand, has written a book "Planer Kinks," for practical planer men and every planer hand should get it; $1 postpaid. Hill Pub. Co., 505 Pearl St., New York.

Salesmen, a paying side-line for you. We will allow a liberal commission for selling a new automatic hose-coupling of exceptional merit which we are placing on the market. This is a rare opportunity to substantially increase your income. Thos. H. Dallett Co., 23d and York, Philadelphia.

Arrange with us to do your manufacturing; we are thoroughly equipped for all classes of machine work, including screw machine and punch parts, tools, jigs, etc.; we also design and build to order special and experimental machinery. Forest City Specialty Manufacturing Co., Rockford, Illinois.

Manufacturing business making a cotton mill specialty will be considered for the investment of a moderate amount of capital; appliance to be considered, must be of proved value and at the present time being manufactured and introduced into the leading mills. Such an article in need of more money to properly push it will receive attention. Box 339, AMERICAN MACHINIST.

We have a special proposition for a few bright, energetic mechanics, such as foremen, draftsmen or machinists in different sections of the country; no canvassing or selling of any kind, and, while not interfering with your regular work, pays well for the time taken; we want only practical men who can be depended on to give the little time required each week; further particulars on application. Box 102, AMERICAN MACHINIST.

Manufacturer Wanted—A modern up to date concern in Eastern territory that is equipped for building medium and heavy machinery to take up the building of an established line of machinery amounting to $200,000 or $300,000 gross annually; would have to bear part of office and selling expense; will deal only with principal of first-class concern and will treat same absolutely confidential. Address New York Established Business, Box 315, AMERICAN MACHINIST.

Save 50 per cent. on the design of electrical equipment, millwright layouts, special automatic machinery, metal working dies, jigs and fixtures; no expenses of non-producers to cover, therefore are in a position to handle your work economically and at a much greater saving in time, than possible even in your own drawing room; we design and develop your ideas, producing good practical working drawings to build from; our designers are capable men, who have had years of practical experience, developing, designing and engineering for some of the foremost concerns in the country. E. A. Johnson Company, 28 Second Place, Brooklyn, N. Y.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Screw machine foreman, wishes position; wide experience and up to date; Brown & Sharpe automatic machines preferred; now employed; go anywhere. "Dartt," AM. M.

Manager, desiring to make a change; solicits correspondence from companies manufacturing interchangeable parts; references and reasons for changing made known to those interested. Box 321, AMER. MACHINIST.

ILLINOIS

Mechanical draftsman; 37 years; would change about Sept. 15; experienced on special machinery, tools, jigs, fixtures; prefer Detroit or vicinity. Box 324, AM. MACH.

Chief assistant, mechanical and electrical engineer for cranes of all kinds, loading bridges, experienced in design, estimating cost, wants change to Illinois or vicinity. Box 327, AMERICAN MACHINIST.

MASSACHUSETTS

An automatic screw machine foreman desires change; thoroughly understands all makes of automatic machines. Address "Automatic," AMERICAN MACHINIST.

A toolmaker with twelve years' practical experience; thoroughly familiar with all kinds of toolwork; also latest shop methods and systems for the rapid production of duplicate parts, desires to take charge of department. Box 325, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman, experienced in special machinery and general engineering wishes a position. Box 305, AMER. MACH.

Draftsman, foreman, practical general mechanic, experienced in designing automatic, special and general machinery, bookbinders' machinery and experimental work, with mechanical inventive ability and a hustler. Address Box 334, AMERICAN MACHINIST.

NEW YORK

By technical college graduate, age 25; experience in mechanical drafting and with engineering contractor. Box 316, AM. MACH.

Superintendent or general foreman wants position, first-class executive and mechanical ability; automobile works preferred; best references. Box 345, AMERICAN MACHINIST.

College graduate, mechanical engineering, 28, with gas company, desires position where natural inventive ability may be used in developing new mechanical ideas. Box 337, AMERICAN MACHINIST.

Wanted—Position as superintendent or works engineer by technical graduate having had charge of various departments in large electrical company for number of years. Box 338, AMERICAN MACHINIST.

Competent graduate, mechanical engineer, open for engagement, now holding responsible position; wide experience in power transmission and pumping machinery; good salesman assistant manager, chief engineer or foreign representative.; German and French. Box 343, AMERICAN MACHINIST.

Mechanical draftsman; 15 years' experience; nine in factory as machinist and toolmaker, three as general foreman, and six years as draftsman, designing special and automatic machinery, high-class tools, compound and sub-press dies, etc., desires position; competent to fill responsible position; best references. Box 341, AMERICAN MACHINIST.

Mechanical draftsman and toolmaker having served apprenticeship at both; am 31 years old, having had a wide experience designing small tools such as jigs, fixtures and automatic machinery for sheet metal goods, having worked in some of the best factories in the East, wishes to change present position and be connected with some good enterprising concern. Address Box 331, AM. M.

I am a foreman pattern maker with fourteen years' experience in all classes of pattern work, five years' as foundry assistant superintendent; my determination to advance more rapidly than possible where now located has prompted this inquiry; I feel I can convince you of my executive ability, tact and energy; am thirty years old and greatly desire to connect myself with a good live company, who will give me the opportunity to apply my every effort to their interest and recognize merit when shown. Address Box 257, AMERICAN MACHINIST.

OHIO

Mechanical draftsman and designer; years' experience designing tools, jigs and special machinery; toolmaker by trade; references. Box 347, AMERICAN MACHINIST.

PENNSYLVANIA

Experienced mechanical draftsman wants position. Apply Box 346, AMER. MACHINIST.

Superintendent; practical sheet metal die and tool maker, hollow ware, deep shells, spinning and general stamping; designer and estimator. Box 326, AMER. MACHINIST.

Wanted—Position as advertising manager with manufacturing concern, preferably in mechanical field, by a woman with years of experience in that capacity and field, with large, representative houses; thoroughly competent to handle printing, illustrating and the preparation of copy; at present employed; reasons for seeking change made known to prospective employer. Box 103, AMERICAN MACHINIST.

WISCONSIN

Draftsman, university graduate, married, 28 years old, with 5 years' experience in steam turbines, boilers, governors and water turbines, wishes position. Box 333, AM. M.

Superintendent, general superintendent or works manager, desires a change on account of family's health; exceptional forte as cost reducer; references A-1. Address Box 342, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted immediately toolmakers on jig and fixture work; state experience and wages. Sutherland Rifle Sight Company, Ltd., New Glasgow, N. S.

Wanted—Several draftsmen with experience on tools and gages for interchangeable work; address with full particulars as to experience, wages required, giving definite time as to commencing work. Ross Rifle Co., Quebec, Canada.

CONNECTICUT

Wanted—First-class all-around machinist for new and general repair work. The New Machine Co., Danbury, Conn.

ILLINOIS

Wanted—Draftsman capable of making first-class patent drawings; would give preference to a man that can do mechanical drafting; position permanent; in replying give age, nationality, salary expected, experience and references. Box 340, AMERICAN MACHINIST.

INDIANA

Wanted—Five good toolmakers and six lathe men; good wages; steady employment. The Western Motor Co., Logansport, Ind.

IOWA

Wanted—Mechanical draftsman; must have large experience in hoisting engines and mine equipment; give age, experience, salary wanted and references in first letter; permanent employment to right man. Ottumwa Iron Works, Ottumwa, Iowa.

MISSOURI

Wanted—Foreman of experience for general machine shop; must have executive ability and be able to make machinery and operators work at maximum efficiency. Write fully giving age, experience and wages wanted. Box 311, AMERICAN MACHINIST.

NEW JERSEY

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—Foundry men and grinders who are sober and industrious and who desire steady work at good wages in an open shop that has been in operation a number of years; no labor difficulties; small improved city, good schools, healthy location with ample opportunity to secure homes at moderate cost; prefer men with families who will remain permanently; answer with particulars as to experience and references. Box 329, AMERICAN MACHINIST.

NEW YORK

Wanted—A pattern maker, married preferred. McEwen Bros., Wellsville, N. Y.

Wanted—First-class toolmakers on tools, jigs and fixtures. Boxes 7 and 8, Syracuse, N. Y.

Wanted—Experienced salesman, not over 30 years, to sell twist drills, milling cutters,

taps, etc.; state particulars. Address "L. C. B.," Box 1347, New York City.

Wanted—Good mechanical draftsman; man with experience on valves preferred. Apply stating age, experience and salary expected. Box 332, AMERICAN MACHINIST.

Wanted—A highly skilled lathe operator, trained on lathes from 20 to 60 in. swing; an extraordinary producer of good work only need apply; big wages to the right man. Address Clark Bros. Co., Belmont, N. Y.

A large manufacturing concern, in the machinery line, wishes to employ a first-class writer of business circular; booklet and newspaper advertising; permanent position and good salary to the right man. Box 312, AMERICAN MACHINIST.

Wanted—High grade mechanic with some traveling experience preferred, to represent a well known manufacturer in St. Louis and surrounding country; must be of good address and understand thoroughly automatic machines, turret lathes, etc.; state age, experience, salary to start and references. Box 348, AMERICAN MACHINIST.

Mechanical engineer wanted, technical graduate, experienced in pipe fittings and millwright work; position in maintenance department of large manufacturing company in New York City; good prospects for man who can produce results; answer giving full particulars as to age, education, experience and salary expected. Box 344, AMER. MACHINIST.

Wanted—General foreman for machine shop employing 75 to 100 men, building machine tools, special machinery, etc.; must be thorough mechanic, with tact, resource and push; capable and familiar with handling men and work to best advantage; good opportunity and future for competent man, with rapidly growing business. Address with full particulars as to experience, age, references, etc. Box 256, AMERICAN MACHINIST.

Machinists for lathes, planers and floor work wanted; day and night shift; we are increasing our force and offer here an excellent opportunity for energetic mechanics who have determination to forge ahead; the future advancement of all our employees depends entirely upon their capabilities and energy; we recognize merit as fast as the opportunity offers; when applying state wages desired. Apply Ingersoll-Rand Co., Painted Post, N. Y.

OHIO

Wanted—Foreman to take charge of shop in Ohio, employing fifty men; must have experience in the manufacture of wood-working machinery; state age, experience, reference and salary. Address Wood, Box 279, AM. M.

Screw machine man to take charge of department and capable of producing results from 3 Bardons & Oliver, 1 Brown & Sharpe, 2 Warner & Swasey hand machines and 4 Cleveland automatic; tool steel work principally; location, Ohio; state experience, age and wages. Address Box 330, AMER. MACH.

PENNSYLVANIA

Wanted—Foreman for gear cutting department; must have experience; apply with particulars to R. D. Nuttall Co., Pittsburg, Pa.

On account of increased business we are constantly in need of high-grade planer, lathe, and boring mill hands also competent erectors, no labor troubles. The Blaisdell Machinery Co., Bradford, Pa.

We are just completing the fitting up of a modern machine manufacturing plant, and invite applications for employment from machinists, pattern makers and molders; steady employment and good wages for reliable and desirable workmen; when writing give full details of experience. The Shepherd Engineering Co., Williamsport, Pa.

Wanted—By leading automobile company of northeastern Pennsylvania, a hustler to take full charge of chassis and transmission department; one who has had extensive experience in that line and must be a man who can turn out work rapidly and accurately; good opening for the right party; state where now employed and give reference as to capabilities and general character, from previous employers. Box 328, AMER. MACH.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery; good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

VIRGINIA

Wanted—Two or three first-class draftsmen, those familiar with steam shovel and dredge designs preferred; give full experience and salary expected. Box 882, Richmond, Va.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, O.

One new No. 2 plain automatic feed Cincinnati miller, with oil pump and tank, and No. 3 plain vise. Immediate delivery. Box 310, AMERICAN MACHINIST.

For Sale—Ten volume library covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volunmes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

One 10x10x12 duplex steam pump; one 10x14x12 Rand air compressor; one No. 3 Toledo punch press; two hydraulic presses, will take in material 35"x35". Shartle Brothers, Middletown, O.

For sale, outright or on royalty; a very profitable machine manufacturing business, on well patented machine, having great demand; owner going to Europe; exceptional chance for larger concern. Box 307, AMER. MACH.

Alphabetical Index to Advertisers

	PAGE
Abrasive Material Co	76
Acme Machinery Co	38
Adams Co	63
Almond Mfg. Co., T. R	82
Alteneder & Sons, Theo	38
American Emery Wheel Wks.	76
American Gas Furnace Co	27
American Pulley Co	92
American Tool & Mach. Co	68
American Tool Works Co., 8 and	98
American Tube & Stamp'g Co.	99
Armstrong-Blum Mfg. Co	77
Armstrong Bros. Tool Co	66
Athol Machine Co	74
Automatic Machine Co	76
Baird Machine Co	80
Baker Bros	74
Baldwin Chain & Mfg. Co	72
Baldwin Steel Co	47
Barnes Co., B. F	71
Barnes Co., W. F. & John	14
Barnett Co., G. & H. . . . 4th cover	
Bartlett, E. E	95
Baush Mach. Tool Co. . . 3d cover	
Bay State Stamping Co	95
Beaman & Smith Co. . . 15 and	82
Beche & Gross	98
Becker-Brainard Milling Machine Co	23
Bemis & Call Hardw. & Tool Co	70
Besly & Co., Chas. H	62
Bethlehem Fdry. & Mach. Co.	68
Bethlehem Steel Co	51
Bickford Drill & Tool Co	10
Bignall & Keeler Mfg. Co	72
Bilgram, Hugo	38
Billings & Spencer Co	67
Binsse Mach. Co	38
Birdsboro Steel Fdry. & Machine Co	74
Birkett Mills	98
Blaisdell Machinery Co	84
Blanchard Machine Co	95
Bliss Co., E. W	25
Blount Co., J. G	32
Boker & Co., Hermann	59
Boston Gear Works	86
Box & Co., Alfred	92
Boynton & Plummer	92
Bradford Machine Tool Co	5
Bridgeport Safety Emery Wheel Co	76
Bristol Co. . . . . 4th cover	
Bristol, Wm. H	38
Brown & Co., R. H	83
Brown Hoisting Machry. Co.	93
Brown & Sharpe Mfg. Co., 1 and 4th cover	
Brubaker & Bros., W. L	73
Buffalo Forge Co. . . . . 4th cover	
Bullard Mach. Tool Co., 37 and	96
Burke Electric Co	90
Burroughs Co., Chas	83
Butterfield & Co	95
Caldwell & Son Co., H. W	90
Carborundum Co	20
Card Mfg. Co., S. W	16
Carpenter Tap & Die Co., J. M	71
Carver File Co	72
Case Mfg. Co	92
C & C Electric Co	89
Chambersburg Engineering Co	69
Champion Tool Works Co	72
Chandler & Farquhar Co	98
Chicago Flexible Shaft Co	67
Chicago Pneu. Tool Co	84
Chicago Rawhide Mfg. Co	87
Cincinnati Electrical Tool Co.	62
Cincinnati Machine Tool Co.	21
Cincinnati Milling Machine Co. . . . . 6 and	7
Cincinnati Planer Co	24
Cincinnati Shaper Co. 102	
Clark Auto. Telephone Switchboard Co	72
Clark Cast Steel Cement Co.	80
Clark, Jr., Electric Co., Jas.	101
Clayton Air Compressor Wks.	84
Cleveland Auto. Mach. Co	18
Cleveland Cap Screw Co	73
Cleveland Crane & Car Co	92
Cleveland Planer Works	95
Cleveland Twist Drill Co., 4th cover	
Cleveland Wire Spring Co. . . . 99	
Clough, R. M	73
Coates Clipper Mfg. Co	68
Coes Wrench Co	27
Colburn Machine Tool Co	25
Cook Co., Asa S	72
Crescent Forgings Co	67
Crocker-Wheeler Co	88
Crosby Steam Gage & Valve Co	17
Cumberland Steel Co	73
Curtis & Co. Mfg. Co	84
Curtis & Curtis Co	72
Cushman Chuck Co	82
Cutler-Hammer Clutch Co	91
Dallett Co., Thos. H	85
Desmond-Stephan Mfg. Co	76
Detrick & Harvey Mach. Co.	70
Diamond Chain & Mfg. Co	73
Diehl Mfg. Co	90
Dill Slotter People	26
Dixon Crucible Co., Joseph	77
Dodge & Day	73
Dreses Machine Tool Co	45
Earle Gear & Mach. Co	87
Eastern Machinery Co	82
Eberhardt Bros. Mach. Co	87
Eck Dynamo & Engine Co	90
Elmes Engineering Works, Chas. F	72
Errington, F. A	83
Evans Friction Cone Co	72
Excelsior Needle Co	71
Fairbanks Co	70
Farrel Fdry. & Mach. Co	80
Fawcus Machine Co	86
Fellows Gear Shaper Co	87
Firth-Sterling Steel Co	79
Fitchburg Machine Works	31
Foote-Burt Co., The	94
Fosdick Machine Tool Co	16
Franklin Mfg. Co., H. H	78
Frevert Machinery Co	94
Gang Co., Wm. E	94
Gardner Machine Co	76
General Electric Co	88
General Pneumatic Tool Co.	93
Geometric Tool Co	21
Gisholt Mach. Co. . . . . 25 and	101
Gleason Works. . . . . 4th cover	
Globe Machine & Stamping Co	73
Goldschmidt Thermit Co	80
Gorton Machine Co., Geo	71
Gould & Eberhardt	66
Graham Mfg. Co	81
Grant Gear Works	86
Grant Mfg. & Mach. Co	71
Gray Co., G. A	38
Gray & Prior Machine Co	99
Greaves, Klusman & Co	69
Hammacher, Schlemmer & Co.	51
Hanna Engineering Works	90
Hardinge Bros	73
Harrington, Son & Co., Edw.	63
Harrison & Knight Mfg. Co	72
Hart & Cooley Co	65
Heald Machine Co	98
Hendey Machine Co	53
Henley Publishing Co., N. W.	21
Henry & Wright Mfg. Co	65
Hill, Clarke & Co., Inc	97
Hill Publishing Co. . . . 38 and	62
Hisey-Wolf Machine Co	26
Hoefer Mfg. Co	17
Hoggson & Pettis Mfg. Co	82
Hopkinson Machine Works	81
Horsburgh & Scott Co. . 4th cover	
Horton & Son Co., E	82
Hunt & Co., Robt. W	73
Hurlbut-Rogers Machine Co.	72
Independent Pneumatic Tool Co	84
Industrial Oxygen Co	80
Ingersoll-Rand Co	85
Ingersoll Milling Mach. Co	92
International Specialty Co	76
Jacobs Mfg. Co	83
Jacobson Mach. Mfg. Co	77
Jantz & Leist Electric Co	90
Jenkins Brothers	77
Johnson Mach. Co., Carlyle	66
Jones & Lamson Mach. Co., 12, 13 and	38
Kelly Co., R. A	82
Kempsmith Mfg. Co	22
Kent Co., Edwin R	80
Keyless Lock Co	72
Keystone Steel Casting Co	78
Keystone Watch Case Co	96
Landis Machine Co	81
Landis Tool Co	47
Lapointe Machine Tool Co	81
Lea Equipment Co. 102	
Le Blond Machine Tool Co., R. K. . . . . 4th cover	
LeCount, Wm. G	82
Lincoln Motor Works Co	90
Link-Belt Co	99
Lodge & Shipley Machine Tool Co	4
Long & Allstatter Co	69
Lucas Mach. Tool Co	61
Lumen Bearing Co	79
Lunkenheimer Co., The	77
Lyon Metallic Mfg. Co	26
Macdonald & Macdonald	72
Main Belting Co	77
Mfg. Equip. & Eng. Co	32
Manufacturers Foundry Co.	78
Maris Brothers	92
Marshall & Huschart Machinery Co	97
Mass. Saw Works	30
McCabe, J. J. . . . . 65 and	96
McDowell, Stocker & Co	98
McLeod & Henry Co	75
Merritt & Co	73
Merritt, Jos	80
Metal Hardening Solution Co.	79
Milton Mfg. Co	57
Miner & Peck Mfg. Co	94

	PAGE
Moore Co., Franklin	93
Morris Fdry. Co., Jno. B.	9
Morse Chain Co.	64
Morse Twist Drill & Machine Co.	49
Morse, Williams & Co.	87
Morton Mfg. Co.	94
Morton & Co., B. K.	80
Mossberg Wrench Co.	94
Motch & Merryweather Machinery Co.	97
Mueller Mach. Tool Co.	69
Mumford Co., E. H.	64
Nash Co., Geo.	62
National-Acme Mfg. Co.	102
National Machinery Co.	73
New Britain Machine Co.	69
New Haven Mfg. Co.	69
New Process Rawhide Co.	87
Newton Machine Tool Works.	11
Nicholls, W. S.	92
Nicholson File Co.	17
Nicholson & Co., W. H.	70
Niles-Bement-Pond Co., 33, 34, 35, 36 and	96
Northern Electrical Mfg. Co.	88
Northern Engineering Wks.	92
Norton Co.	45
Norton Grinding Co.	30
Nuttall Co., R. D.	86
Nutter, Barnes & Co.	69
Obermayer Co., The S.	78
Oesterlein Machine Co.	94
O. K. Tool Holder Co.	68
Owen Machine Tool Co.	22
Page-Storms Drop Forge Co.	81
Parker Co., Chas.	81
Patterson, Gottfried & Hunter, Ltd	71
Pawling & Harnischfeger	92
Paxson Co., J. W.	84
Philadelphia Bourse	70
Philadelphia Gear Works	86
Pike Mfg. Co.	57
Pittsburg Automatic Vise & Tool Co.	81
Poole Co., J. Morton	68
Potter & Johnston Mach. Co.	53
Pratt Chuck Co.	82
Pratt & Whitney Co. 2 and	3
Prentice Bros. Co.	29
Prentiss Tool & Supply Co.	96
Queen City Mach. Tool Co.	73
Rahn-Carpenter Co.	94
Ransom Mfg. Co.	76
Reed Mfg. Co.	81
Reichhelm & Co., E. P.	4th cover
Reinforced Brazing & Mach. Co.	78
Ridgway Dynamo & Eng. Co.	89
Rivett-Dock Company	3d cover
Rivett Lathe Mfg. Co.	3d cover
Rockford Machine Tool Co.	87
Rock Island Tool Co.	81
Rockwood Mfg. Co.	93
Rogers Works, John M.	90
Rogers & Hubbard Co.	70
Roth Bros. & Co.	89
Rowell Co., W. G.	80
Royersford Foundry & Machine Co.	72
Safety Emery Wheel Co.	76
Saunders Sons, D.	68
Sawyer Gear Works.	86
Schieren & Co., Chas. A.	95
Schumacher & Boye	9
Scranton & Co., The	80
Sebastian Lathe Co.	65
Sellers & Co., Wm.	28
Seneca Falls Mfg. Co.	64
Shelby Steel Tube Co.	80
Shultz Belting Co.	95
Sibley Machine Tool Co.	68
Skinner Chuck Co.	82
Skinner Shipbuilding & Dry Dock Co.	72
Slate Machine Co., Dwight	71
Sloan & Chace Mfg. Co.	14
Slocomb Co., J. T.	75
Smith Countershaft Co.	31
Smith & Mills.	94
Spacke Machine Co., F. W.	84
Spicer Universal Joint Mfg. Co.	73
Sprague Electric Co.	91
Springfield Machine Tool Co.	15
St. Mary's Machine Co.	77
Standard Connecting Rod Co.	77
Standard Engineering Works	73
Standard Gauge Steel Co.	95
Stark Tool Co.	95
Starrett Co., L. S.	100
Steptoe Shaper Co., John	81
Stoever Fdry. & Mfg. Co.	67
Struthers-Wells Co.	77
Sturtevant Co., B. F.	26
Tabor Mfg. Co.	64
Taylor & Fenn Co.	70
Taylor-Wilson Mfg. Co.	86
Toomey, Frank	98
Triumph Electric Co.	90
Turner Brass Works	72
Turner Mach. Co.	69
Underwood & Co., H. B.	68
Union Twist Drill Co.	55
United Engineering & Fdry. Co.	63
U. S. Electrical Tool Co.	75
Van Dorn & Dutton Co.	88
Vandyck Churchill Co.	63
Vitrified Wheel Co.	76
Von Wyck Machine Tool Co.	94
Walcott & Wood Mach. Tool Co.	73
Waltham Machine Works.	73
Waltham Watch Tool Co.	93
Ward & Sons, Edgar T.	79 and 80
Warner Instrument Co.	70
Warner & Swasey Co.	100
Waterbury Farrel Foundry & Mach. Co.	71
Watson-Stillman Co.	75
Wells Bros. Co.	74
West Haven Mfg. Co.	4th cover
Westinghouse Elec. & Mfg. Co.	89
Westmacott Gas Furnace Co.	94
Weston Elec. Instrument Co.	90
Whitcomb-Blaisdell Mach. Tool Co.	19
Whitman & Barnes Mfg. Co.	66
Whitney Mfg. Co	44
Whiton Machine Co., D. E.	82
Wiley & Russell Mfg. Co.	94
Williams, Brown & Earle	98
Williams Valve Co., D. T.	101
Williamson Vise Co.	81
Wilmarth & Morman Co.	76
Windsor Machine Co.	95
Wood's Sons Co., T. B.	93
Woodward & Powell Planer Co.	94
Worcester Machine Screw Co.	94
Wormer Machry. Co., C. C.	97
Wyman & Gordon Co.	4th cover
Yale & Towne Mfg. Co.	93

Classified Index to Articles Advertised

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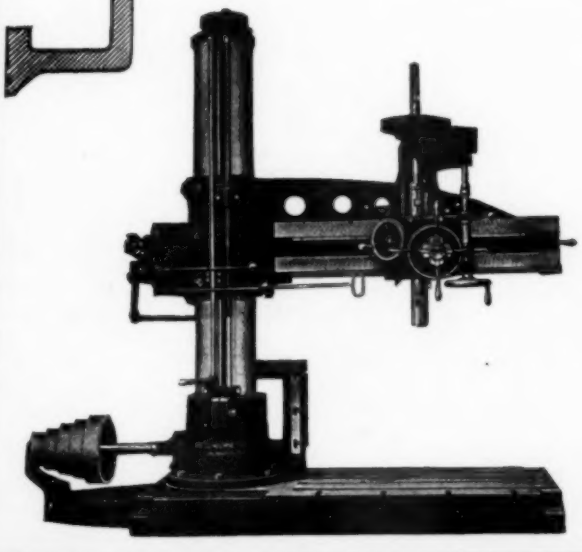

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Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, O.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond, Tools
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.

Dies, Sub-Press
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, O.
Mittineague Paper Co., Mittineague, Mass.

Drawing Materials
Alteneder & Son, Theo., Philadelphia, Pa.
Mittineague Paper Co., Mittineague, Mass.
Technical Supply Co., Scranton, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell - Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Dallett Co., Thos. H., Phila., Pa.
Bickford Drill & Tool Co., Cincinati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric
Chicago Pneumatic Tool Co., Chicago, Ill.
Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinati, O.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Ct.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, O.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry Co., Chicago, Ill.
McCabe, J. J., New York.

Drilling Machines, Upright—*Continued.*
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Clayton Air Compressor Works, New York.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Hisey-Wolf Mach. Co., Cin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder
Graham Mfg. Co., Providence, R. I.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.